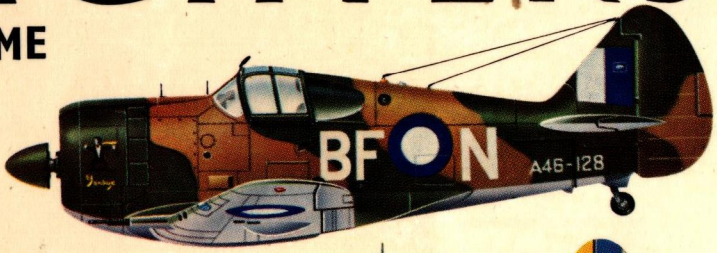
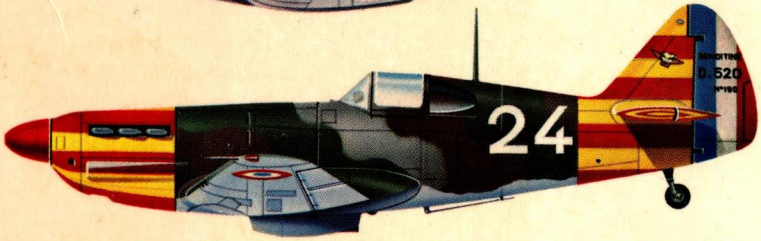
WAR PLANES OF THE SECOND WORLD WAR

FIGHTERS

VOLUME ONE





WILLIAM GREEN

FIGHTERS VOLUME ONE

DOUBLEDAY

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WAR PLANES OF THE SECOND WORLD WAR

by

William Green

F I G H T E R S

Volume I

Australia, Belgium

Bohemia-Moravia, Finland

France, Germany

Cover illustrations:

Top: **COMMONWEALTH CA-13 BOOMERANG** (A46–128) of No. 5 Sqn. R.A.A.F., Mareeba, Queensland; Spring 1944.

Centre: **DEWOITINE D.520** (No. 190) of Groupe de Chasse III/6, 6th Escadrille, Vichy Air Force, Algiers/Maison Blanche; 1942.

Bottom: **MESSERSCHMITT Bf 109F–2** of 8./JG 54 "Grünherz", Siverskaya (Leningrad Front); Autumn 1941.

WAR PLANES FIGHTERS I DOUBLEDAY

WAR PLANES OF THE SECOND WORLD WAR

FIGHTERS

VOLUME ONE

WILLIAM GREEN

With Drawings by Dennis I. Punnett

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INTRODUCTION

Twenty years ago, in August 1940, the epic aerial conflict of all time, the "Battle of Britain", was being fought out in the skies over southern England; a struggle upon the outcome of which hinged not only Britain's ability to resist invasion from the European continent but also victory in the Second World War. In the final analysis the "Battle" rested much upon the relative merits of the opposing fighters; Germany's Messerschmitt Bf 109Es and Bf 110Cs and Britain's Spitfires and Hurricanes. The Luftwaffe's fighters which, after an abortive attempt to destroy R.A.F. Fighter Command, were allocated the unenviable task of protecting the bombers from the attentions of R.A.F. fighters, laboured under serious disadvantages resulting from their escort responsibilities and, in the case of the single-seaters, the ranges over which they were forced to operate. The Bf 109E and the Spitfire proved fairly evenly matched, each having certain advantages over its adversary which cancelled out, but the Bf 110C was found wanting as was also the Hurricane in fighter-versus-fighter combat, and the complacency of the opposing air arms in the superiority of their respective fighter craft was cracked if not shattered. Thus began a fantastic acceleration of the struggle to achieve technical superiority in fighter development; a struggle which, in the short space of a few years, resulted in a remarkable metamorphosis in fighter design. A similar transformation took place in the design of other types of warplane, and in *War Planes of the Second World War* I have attempted to provide a *complete* picture of this amazing development.

Unlike any other reference to the aircraft of the conflict, *War Planes of the Second World War* is not devoted solely to those machines which actually saw *combat* with their respective air arms; it records full details of those which, for one reason or another, failed to attain service. *War Planes of the Second World War* is the distillation of many years of research and, for ease of reference, has been divided into a series of compact volumes, the first trio of which cover the fighters and fighter-bombers of each of the warring nations. The criterion for the inclusion of an aircraft has been: (1) its service use during the conflict; (2) its development and testing during the war years, or (3) in the case of aircraft of pre-war origin, the active pursuance of its development after the commencement of fighting. This, the first volume, deals with the fighters of Australia, Belgium, Bohemia-Moravia, Finland, France and Germany, and many of the aircraft to be found within the pages that follow have never been illustrated or described in detail previously.

In conclusion, I should like to record my sincere thanks to my friends Gert W. Heumann and Pierre Leyvastre without whose indefatigable labours this volume would have been far less comprehensive; to Dennis I. Punnett who, by dint of burning much midnight oil, has produced a series of general arrangement drawings which I have no hesitation in claiming to be the most accurate yet published; to Jacques Tiziou, Egon Krueger, Roland de Narbonne, Mauno Salo, Howard Levy, and lastly, but by no means least, my good friend Walter Parrish of Macdonald and Company who undoubtedly suffered as many headaches with the production of this book as I did during its compilation.

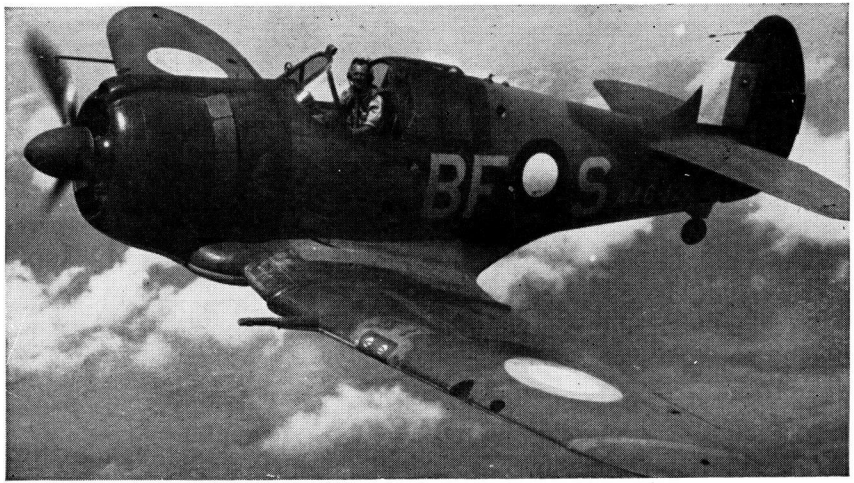
London, August 1960 William Green

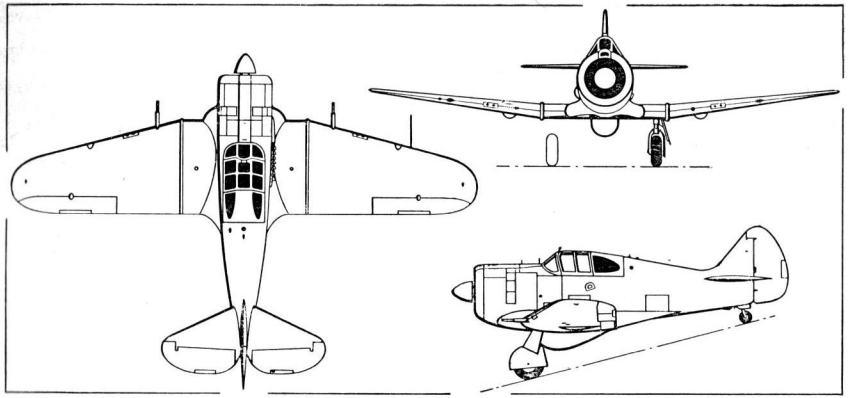
COMMONWEALTH CA-12 BOOMERANG AUSTRALIA

The CA-12 Boomerang may be considered as a "panic fighter". When the Japanese struck in the Pacific, the R.A.A.F. had no fighters, apart from the Brewster Buffaloes of Nos. 21 and 453 Squadrons in Malaya, and neither the U.K. nor the U.S.A. had any to spare. Thus, an indigenous fighter was rapidly developed. It was designed around the largest engine available in Australia, the Twin Wasp, and in order to accelerate development, as many components of the Wirraway trainer (North American NA-33) as practicable were employed.

The first Boomerang (A46-1) was flown on May 29, 1942, only fourteen weeks after its design had been approved, an initial order for 105 machines being placed. From mid-1943 the Boomerang did extremely valuable work in the tactical role, supporting the Australian Army in New Guinea. Although relatively slow and therefore incapable of facing contemporary Japanese fighters on even terms, its extreme manoeuvrability proving a great asset over the mountainous and heavily wooded terrain of New Guinea, and it served as a bomber interceptor, ground strafer and photo-reconnaissance machine. A total of 250 Boomerangs

A CA-12 Boomerang fighter-bomber of No. 5 Squadron, R.A.A.F.





was built by Commonwealth Aircraft's Fishermen's Bend factory.

The Boomerang retained the principal distinctive features of the Wirraway, including the rectangular centre section and tapered outer sections of the wing, the continuous flaps between the ailerons, and the inward retracting undercarriage with wheel wells forward of the wing main spar and protruding ahead of the leading edge. The tail assembly was also similar. The pilot's cockpit was amply protected with armour plate and a bullet-proof windscreen was provided. The fuselage structure comprised a welded chrome-molybdenum steel-tube framework with metal and fabric skinning; the wings were single-spar structures with stressed-skin covering, and the control surfaces were fabric-covered.

Close co-operation between Army and Air Force was in many cases brought to a fine art by Boomerang pilots, and this little fighter found an affectionate place in the hearts of the pilots who flew it and in the Army with which it co-operated. Operating under Army control, the Boomerangs were used to lead bomber formations to specific targets by dropping smoke bombs and strafing with tracer bullets.

Type: *Single-seat Interceptor, Reconnaissance-fighter and Fighter-bomber.* **Power Plant:** *One* 1,200 *h.p. Pratt and Whitney R*-1830-*S*3*C*4*G Twin-Wasp fourteen-cylinder two-row air-cooled radial.* **Armament:** *Two* 20-*mm. Hispano cannon and four* 0.303-*in. Browning machine guns.* (*Fighter-bomber*) *One* 500-*lb. bomb.* **Performance:** *Maximum speed,* 296 *m.p.h. at* 7,600 *ft.,* 273 *m.p.h. at sea level; service ceiling,* 29,000 *ft.; range,* 930 *mls. at* 190 *m.p.h. at* 15,000 *ft.; maximum endurance,* 4.9 *hrs.* **Weights:** *Empty,* 5,450 *lb.; normal loaded,* 7,000 *lb.; max.,* 7,600 *lb.* **Dimensions:** *Span,* 36 *ft.* 3 *in.; length,* 25 *ft.* 6 *in.*

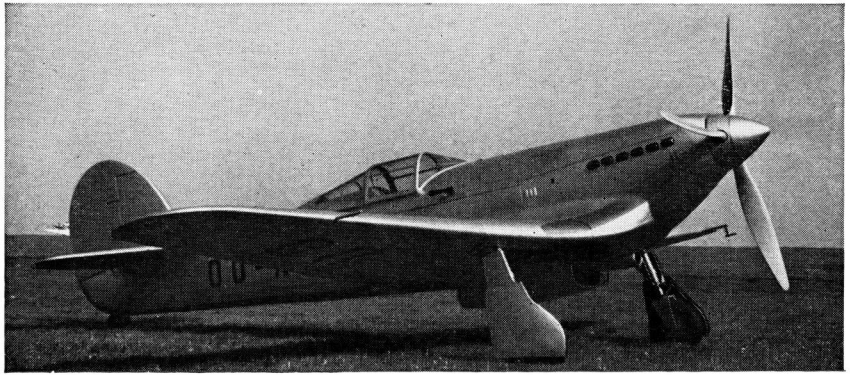
RENARD R-38

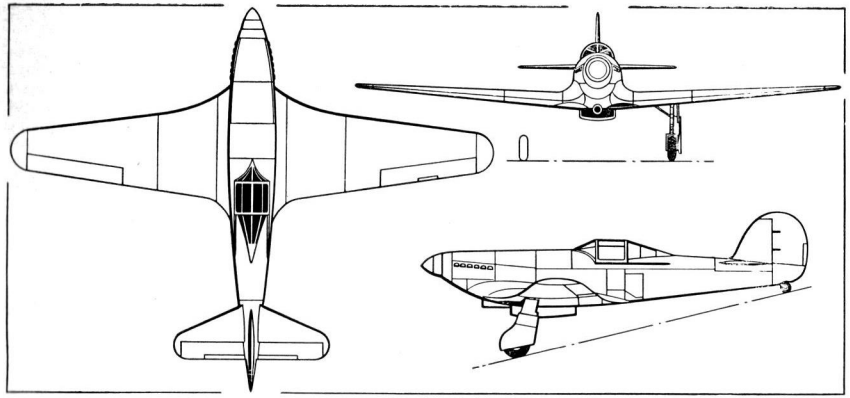
BELGIUM

In 1936, M. Alfred Renard of Constructions Aéronautiques G. Renard began the design of a single-seat fighter which, designated R-36, flew for the first time at Haren-Bruxelles on November 5, 1937. The R-36, which was powered by a 910 h.p. Hispano-Suiza 12Ycrs liquid-cooled engine, carried an armament of one engine-mounted 20-mm. Hispano-Suiza cannon and four wing-mounted 7.7-mm. Browning machine guns, and attained a maximum speed of 313 m.p.h. at 13,120 ft. In January 1939, after forty-five hours of flight testing, the R-36 was destroyed, but during the previous year, a second prototype, the R-37 powered by a 1,050 h.p. Gnôme-Rhône 14 N.21 air-cooled radial, had been demonstrated before the French authorities at Villacoublay. This variant attained 325 m.p.h. at 16,400 ft. and carried an armament of four 7.7.-mm. Browning guns.

A third prototype, the R-38, was demonstrated to the Belgian authorities on July 18, 1939, and differed from its predecessors principally in having a Rolls-Royce Merlin II engine. The fuselage was a rectangular metal structure fairing to an oval section aft, and the wing was an all-metal three-section, three-spar structure, the whole being covered by duralumin sheet apart from the rear fuselage and rudder which were fabric-covered. The prototype R-38 had completed a considerable amount of testing when German forces invaded Belgium, and was subsequently flown to France and then to Morocco.

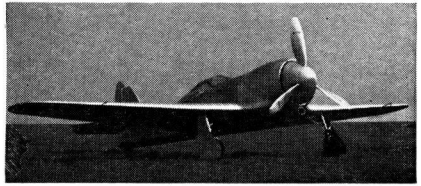
One further version of the design was built. This, the R-40 ordered by the French Air Ministry, was a pressurised high-altitude interceptor powered by a Rolls-Royce Merlin engine. A unique feature of this aircraft was the provision of an ejectable pilot capsule. Externally similar to the R-38, the R-40 was transported to France for trials and may be presumed to have been destroyed there during the German onslaught.





Type: *Single-seat Interceptor and Fighter-bomber.* **Power Plant:** *One* 1,030 *h.p. Rolls-Royce Merlin II twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Four* 7.7-*mm. Browning machine guns and eight* 22-*lb. bombs.* **Performance:** *Maximum speed,* 267 *m.p.h. at sea level,* 292 *m.p.h. at* 6,560 *ft.,* 336 *m.p.h. at* 19,685 *ft.; climb to* 16,354 *ft.,* 5 *min.* 3 *sec.; service ceiling,* 37,720 *ft., absolute ceiling,* 42,310 *ft.; range,* 620 *mls.* **Weights:** *Empty,* 4,319 *lb.; loaded,* 5,719 *lb.* **Dimensions:** *Span,* 38 *ft.* 2 *in.; length,* 28 *ft.* 10 *in.; height,* 9 *ft.* 6 *in.; wing area,* 215.278 *sq. ft.*

(Above) The R-36 and (below) the R-37 had identical airframes to the R-38 on opposite page.

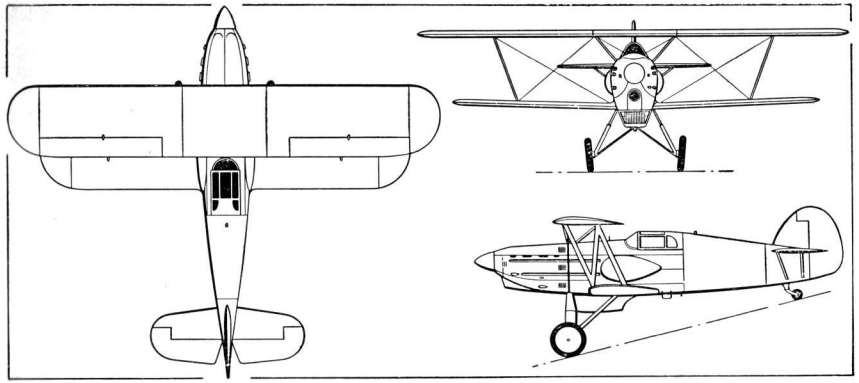


AVIA B-534

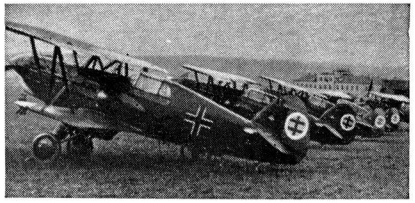
BOHEMIA-MORAVIA

By the beginning of the Second World War, the fighter biplane was almost universally considered obsolete, yet a few such aircraft lingered on with the operational elements of several air arms, and one of these was the Avia B-534. A product of the Avia works at Prague-Letnany, a subsidiary of the well-known Skoda works, the B-534 stemmed from the B-34 of 1932. The B-34, powered by a 650 h.p. Avia Vr 36 liquid-cooled engine, was placed in production for the Czech Army Air Force and, simultaneously, its manufacturers initiated work on several variants with alternative power plants. These included the B-134 (700 h.p. Walter Mistral 14Kbs), the B-234 (580 h.p. Avia Rr 29), the B-334 (490 h.p. Armstrong-Siddeley Jaguar), and the B-434 (650 h.p. Hispano-Suiza Xbrs).

In the summer of 1933, the B-234 was re-engined with a 750 h.p. Hispano-Suiza 12Ydrs to serve as the prototype B-534-I. This attained 227 m.p.h. during trials but the improved second prototype, the B-534-II, reached 245 m.p.h. in level flight, and production orders were placed on behalf of the Czech Army. A variant with a 20-mm. Hispano-Suiza HS-402 cannon mounted between the engine cylinder banks was designated Bk-534. The Avia B-534 closely contested the successes of the Messerschmitt Bf 109 at the International Flying Meeting held at Zurich in July 1937, and by this time the improved B-534-III and IV were in production. The B-534-III introduced an enclosed cockpit canopy, and the B-534-IV featured several improvements, including a slightly uprated engine.



When German forces occupied Bohemia and Moravia, large quantities of B-534 fighters together with substantial supplies of spares were seized. These were used by the Luftwaffe as fighter trainers and glider tugs, but with the formation of the Slovak Air Force under Luftwaffe patronage, three fighter squadrons, the 11th, 12th and 13th were formed and equipped with B-534s. All three squadrons were sent to the Russian front in July 1941, fighting over the Kiev sector. However, the morale of the pilots was low, few being in sympathy with the German-controlled Slovak government, and the squadrons did not distinguish themselves in combat. A generally improved version of the B-534-IV, the B-634 with spatted cantilever undercarriage, was flown in prototype form.

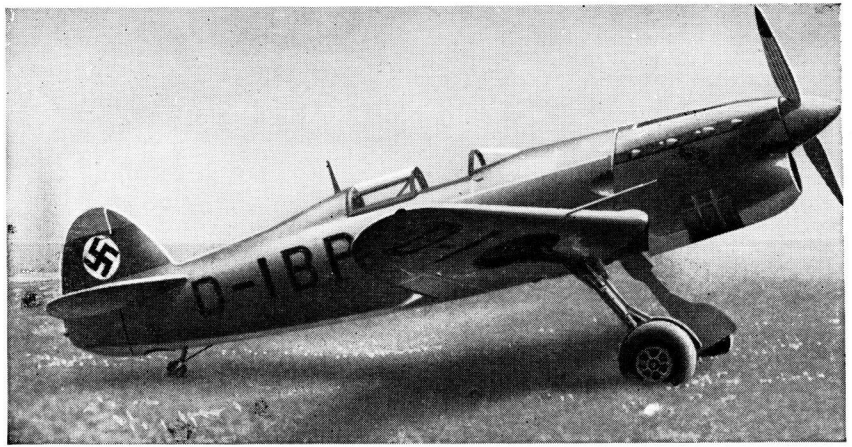


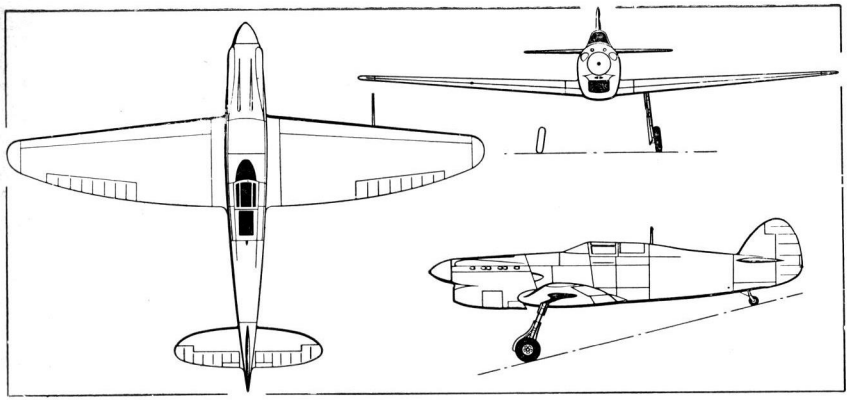
Type: *Single-seat Fighter.* **Power Plant:** *One* 850 *h.p. Avia-built Hispano-Suiza* 12*Ydrs twelve-cylinder liquid-cooled inline engine.* **Armament:** *Four* 7.7-*mm. machine guns.* **Performance:** *Maximum speed,* 245 *m.p.h. at* 14,435 *ft.,* 214 *m.p.h. at sea level; cruising speed,* 215 *m.p.h. at* 14,435 *ft.; initial climb rate,* 2,950 *ft./min.; time to* 16,400 *ft.,* 5 *min.; maximum ceiling,* 34,875 *ft.* **Weights:** *Empty,* 3,218 *lb.; loaded,* 4,365 *lb.* **Dimensions:** *Span,* 30 *ft.* 10 *in.; length,* 26 *ft.* 10¾ *in.; height,* 9 *ft.* 2¼ *in.; wing area,* 253.597 *sq. ft.*

Early in 1938, prior to Czechoslovakia's loss of her historic mountainous frontiers as a result of the Munich Agreement, the Czech government placed a development contract with the Cakovice factory of the Avia concern for a single-seat fighter, the design of which had been initiated in the previous year by Frantisek Novotny. The new fighter employed mixed construction, the elliptical wing being a wooden structure covered by plywood bonded to aluminium sheet, and the fuselage having a tubular steel frame with light alloy skinning forward of the cockpit and fabric covering aft.

As originally conceived, the fighter was to have used the new 1,000 h.p. Avia 12Y-1000.C engine and employ a retractable undercarriage. The Avia engine was not available for installation in the prototype, the Av-35-1, however, and an 850 h.p. Avia-built Hispano-Suiza 12Ydrs engine was substituted. A fixed, spatted cantilever undercarriage was fitted to speed development, and the Av-35-1 first flew in the summer of 1938, displaying excellent handling qualities and attaining a speed of 307 m.p.h. during early flight trials.

Unfortunately, the first prototype was destroyed in November 1938, but a second prototype, the Av-35-2, flew during the following February, this differing from its predecessor in having ailerons of reduced area and enlarged flaps. Despite the dissolution of the Czechoslovak Republic in March 1939, and





the German occupation of Bohemia-Moravia, development of the new fighter continued, a third prototype, the Av-35-3, flying in August 1939. This prototype, which featured a retractable undercarriage and was displayed at the Salon de l'Aéronautique in Brussels, was evaluated by the Germans who ordered its continued development.

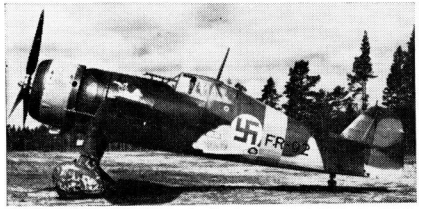
The Av-35-3 formed the basis for the improved Av-135 which differed principally in having a wing of improved profile, the curved wing leading edges of the Av-35 being replaced by straight leading edges. A Bulgarian military mission evaluated the Av-135 and placed an order for twelve machines, simultaneously acquiring a manufacturing licence for the fighter. The twelve Av-135 fighters were delivered to the Bulgarian Air Force in 1941, and detailed drawings were delivered to the Bulgarian State Aircraft Works at the same time, although no licence production was subsequently undertaken. The Bulgarian Av-135 fighters were powered by Avia-built Hispano-Suiza 12Ycrs engines as the occupation of Bohemia-Moravia had interrupted preparations to place the Avia 12Y-1000.C engine in production. With the completion of the Bulgarian order development of the Av-135 was terminated.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 890 *h.p. Avia H.S.*12*Ycrs twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One* 20*-mm. cannon and two* 7.9*-mm. machine guns firing through the airscrew disc.* **Performance:** *Maximum speed,* 332 *m.p.h.; cruising speed,* 286 *m.p.h.; initial climb rate,* 2,657 *ft./min.; service ceiling,* 27,890 *ft.; range,* 342 *mls.* **Weights:** *Empty,* 4,241 *lb.; loaded,* 5,428 *lb.* **Dimensions:** *Span,* 35 *ft.* 7 *in.; length,* 27 *ft.* 10¾ *in.; height,* 8 *ft.* 6½ *in.; wing area,* 182.986 *sq. ft.*

V.L.-FOKKER D.XXI

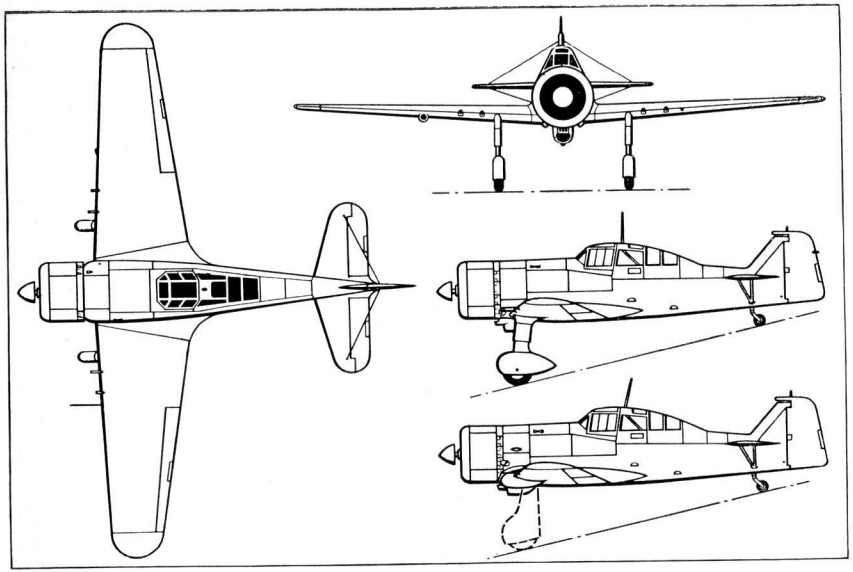
FINLAND

In 1937 the Finnish Government placed an order with the Dutch Fokker company for seven D.XXI fighters and, simultaneously, acquired a manufacturing licence for the type, which was placed in production at the Valtion Lentokonetehdas, or State Aircraft Factory, deliveries commencing in 1939, thirty-eight machines being completed in that year. These, like the original Dutch model, were powered by the 830 h.p. Bristol Mercury VIII, and entered service with HLeLv.24 of the Second Finnish Air Regiment. When the Soviet Union launched her assault on Finland on November 30, 1939, the V.L.-built D.XXIs were immediately involved in the fighting and were responsible for the first Finnish air victory.



Mercury-D.XXI and (below) R-1535-D.XXI.

Throughout 1940 the V.L. was preoccupied with the repair and overhaul of machines employed in the "Winter War", and the further production of the D.XXI had to be postponed until 1941. As available supplies of Mercury



engines were required for the licence-built Bristol Blenheim bombers, eighty Pratt and Whitney R-1535 Twin Wasp Junior engines had been acquired from the U.S.A. in 1940, and the V.L. redesigned the D.XXI for this power plant. The greater weight of the American engine necessitated some shortening of the engine bearers to maintain the c.g., and, in consequence, an increase in the area of the vertical tail surfaces. The two fuselage-mounted guns were transferred to the wings, and the transparent panelling of the cockpit was extended to improve visibility to the rear.

Owing to the increased loaded weight, the R-1535-powered D.XXI had a slightly reduced performance and was not so manoeuvrable as the Mercury-powered model. Production went ahead rapidly, however, fifty being delivered during 1941. When hostilities between the Soviet Union and Finland were resumed, HLeLv.32, to which the surviving Mercury-powered D.XXIs had been transferred after the "Winter War", possessed seventeen Mercury-powered D.XXIs and nineteen

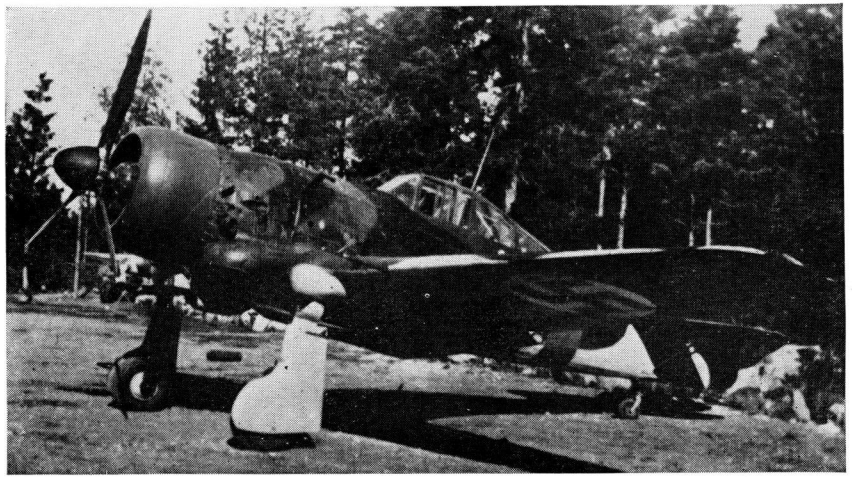
R-1535-powered machines. Six of the veteran Mercury-powered D.XXIs destroyed two Ilyushin DB-3 bombers while protecting the main railway junction at Riihimäki in the first interception after the resumption of hostilities.

No additional D.XXIs were produced by the V.L. until 1944 when a further five machines were completed, but the Finnish concern undertook a certain amount of design development on the fighter, fitting one machine with a fully retractable undercarriage.

The V.L.-built D.XXI should be compared with the Fokker-built D.XXI described in Volume III, pages 100–103.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 825 *h.p. Pratt and Whitney R*-1535 *Twin Wasp Junior SB*4-*G fourteen-cylinder air-cooled radial engine.* **Armament:** *Four* 7.9-*mm. machine guns mounted outboard of the undercarriage.* **Performance:** *Maximum speed,* 272 *m.p.h. at* 9,000 *ft.; cruising speed,* 221 *m.p.h. at* 525 *h.p. at* 14,000 *ft.; climb to* 3,280 *ft.* 1.4 *min., to* 9,840 *ft.,* 4.5 *min.; service ceiling,* 32,000 *ft.* **Weights:** *Empty,* 3,380 *lb.; loaded,* 4,820 *lb.* **Dimensions:** *Span,* 26 *ft.* 1 *in.; length,* 26 *ft.* 3 *in.; height,* 9 *ft.* 2¼ *in.; wing area,* 172.223 *sq. ft.*

One V.L.-built D.XXI fighter was fitted with an inward retracting undercarriage.

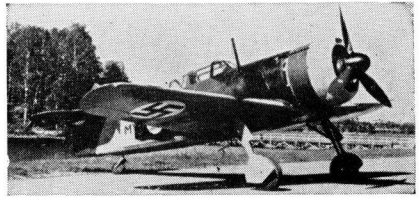


V.L. MYRSKY II

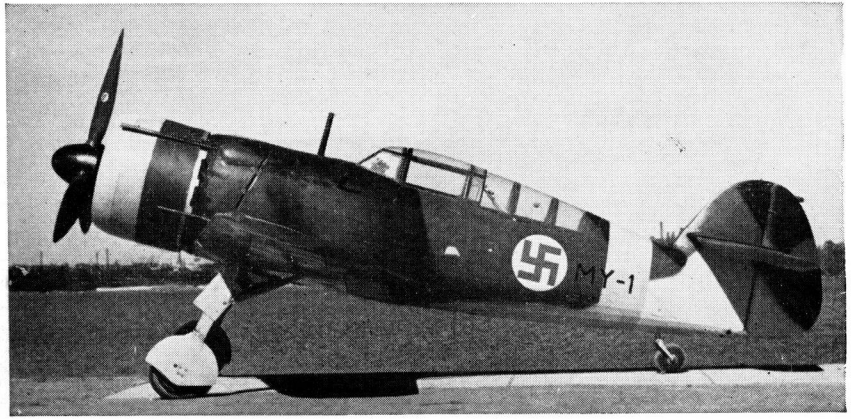
FINLAND

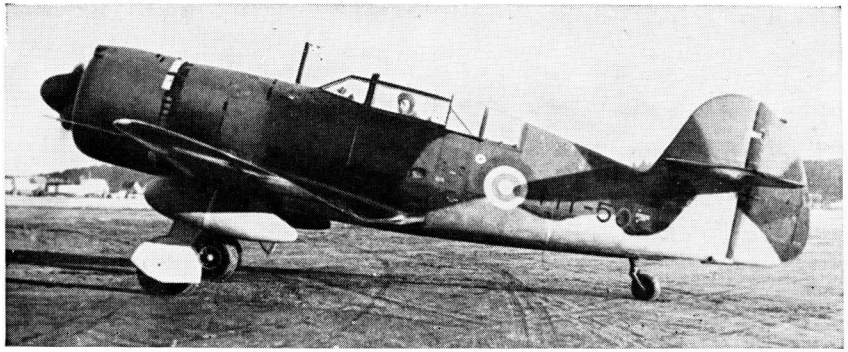
Despite the fact that Finland's wartime aircraft industry consisted of little more than the Valtion Lentokonetehdas, or State Aircraft Factory, the Finns succeeded in placing a fighter of indigenous design in production while, simultaneously, producing the Fokker D.XXI fighter and Bristol Blenheim bomber under licence.

The new fighter, designed by Dipl. Ing. E. Wegeluis, was known as the Myrsky (Storm) and was powered by a Swedish-built version of the Twin Wasp SC3-G fourteen-cylinder air-cooled radial. Mixed construction was employed, the single-piece wing comprising two wooden box spars with plywood ribs and skinning, and the fuselage being a welded chrome-molybdenum steel tube structure with metal skinning forward and plywood skinning aft. All instruments were of Finnish manu-



*(Below and right). The first Myrsky prototype (M Y-*1*) which flew in* 1942 *but crashed under test.*



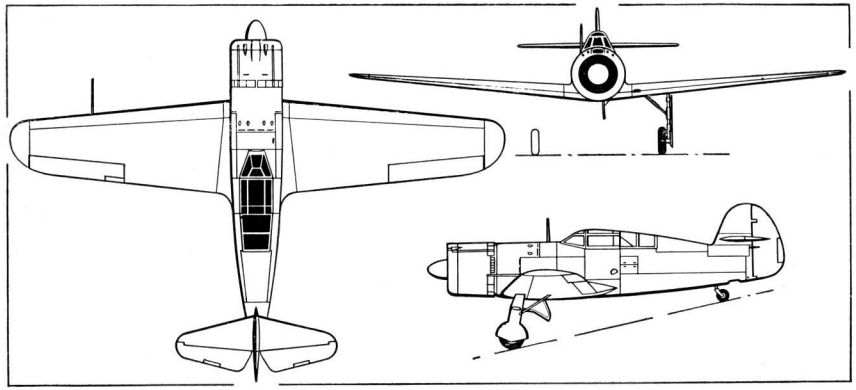


The forty-sixth Myrsky II fighter (MY-50).

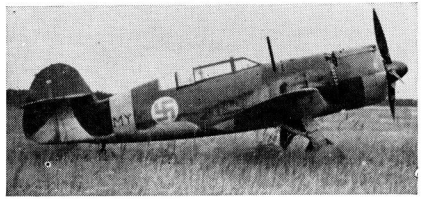
facture as were also the compressed wooden airscrew blades.

The first Myrsky (MY-1) flew for the first time in 1942, and this, together with the three following machines, was designated Myrsky I. The new fighter suffered its full share of teething troubles. Defective bonding resulted in the plywood skinning peeling off under stress; the undercarriage proved to be weak; inadequate longitudinal stability manifested itself, and fractures at the wing attachment points demanded the complete redesign and restressing of the wing. All four Myrsky Is—the last two of which were actually the first two production machines—were lost in accidents, and the third production machine (MY-5) embodied all the modifications dictated by trials with the first four machines and was designated Myrsky II. Forty-six additional Myrsky II fighters were manufactured during 1944, but these reached the Finnish Air Force too late to see combat service against the Russians. However, the peace terms accepted by the Finnish government on September 4, 1944, stipulated Finnish assistance in removing the German forces from northern Finland, necessitating the Finns fighting their erstwhile allies. During subsequent operations Myrsky II fighters were half-heartedly used to harass the withdrawing German forces, but the fighter was not very successful and was not popular with its pilots.

Before the Finnish acceptance of the Russian peace terms, an improved version of the fighter,



the Myrsky III, had entered production at the V. L. Tampere factory, the first of these being MY-52, and ten machines of the improved type were in various stages of completion when the Allied Control Commission brought further production of the Myrsky to a halt. It is of interest to note that, at one time, the Swedish government contemplated the purchase of a manufacturing licence for the Myrsky, but the troubles experienced by the Myrsky prototypes and the success of the nationally-designed F.F.V. J 22 fighter led to the abandoning of this proposal.



The first Myrsky II fighter (MY-5)

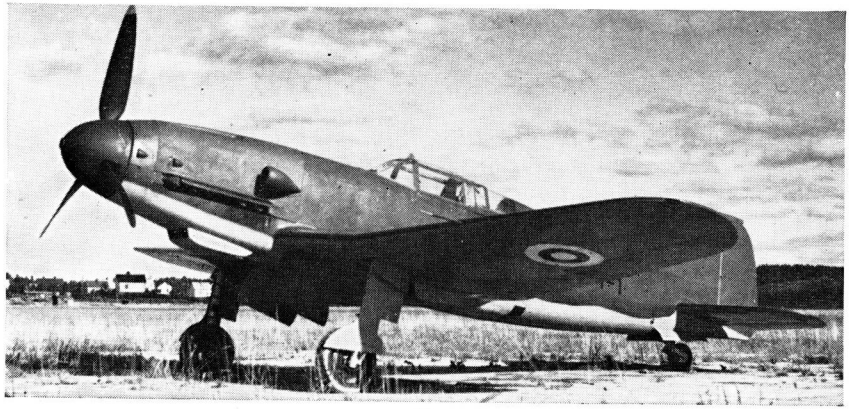
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,065 *h.p. SFA-built Pratt and Whitney Twin Wasp SC3-G fourteen-cylinder air-cooled radial engine.* **Armament:** *Four* 12.7-*mm. Browning MG*-53-2 *machine guns installed in the fuselage and firing through the airscrew disc.* **Performance:** *Maximum speed,* 329 *m.p.h.; cruising speed,* 248 *m.p.h.; range* (66 *Imp. gal. internally*), 310 *mls.; maximum endurance* (*with two* 33 *Imp. gal. drop tanks*), 3 *hrs.; maximum range,* 580 *mls.; service ceiling,* 29,500 *ft.* **Weights:** *Empty,* 5,141 *lb.; normal loaded,* 6,497 *lb.; maximum,* 7,080 *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.; length,* 27 *ft.* 4¾ *in.; height,* 9 *ft.* 10 *in.; wing area,* 193.75 *sq. ft.*

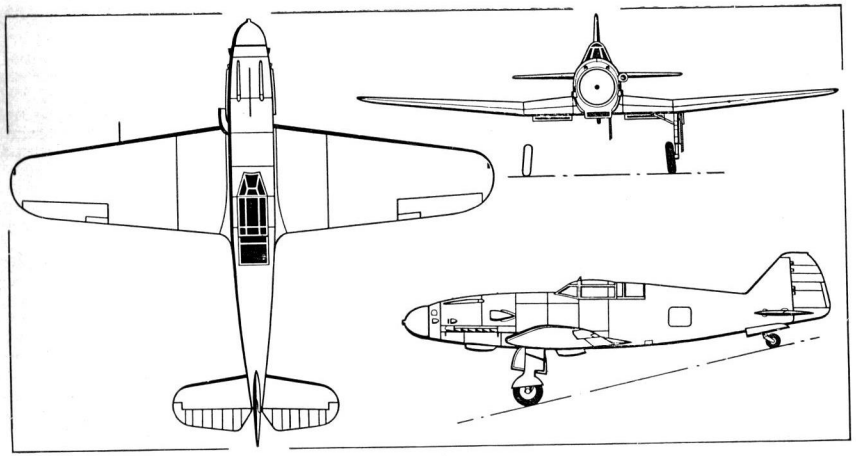
V. L. PYÖRREMYRSKY

FINLAND

When Finnish forces resumed hostilities against the Soviet Union as an ally of Germany on June 22, 1941, the Finns rapidly regained the territory lost by the terms of the Armistice which, on March 13, 1940, had terminated the earlier Russo-Finnish conflict. Owing to the limitations of the aerial warfare during the opening stages of the new conflict, the relative obsolescence of most Finnish fighters did not prove serious until, towards the end of 1942, a noticeable improvement in the quality of Russian flying personnel engaged on the Finnish Front was accompanied by the introduction of the Lavochkin La-5 fighter. Finnish fighters were no match for the newer Russian machines, and, on March 12, 1943, the first of thirty Bf 109G-2 fighters were transferred to the Finnish Air Force as a stopgap. During the following autumn, 132 Bf 109G-6 fighters were delivered to Finland but, in the meantime, the Valtion Lentokonetehdas, or State Aircraft Factory at Tampere, had initiated work on an indigenous fighter design intended specifically to counter the La-5 and other modern Russian fighters.

The design of the new fighter, which was known as the Pyörremyrsky (Whirlwind) commenced in the spring of 1943. The State Aircraft Factory had devoted considerable attention to the investigation of the suitability of national timbers for aircraft construction, and the fighter, which bore a superficial resemblance to the Messerschmitt Bf 109F, was largely built of wood. The single-spar wooden wing had a plywood skin with metal-framed, fabric-covered control surfaces. The rear fuselage was a wooden monocoque of pine and plywood, and the fixed tail surfaces were of wood, the movable surfaces being metal-framed with fabric covering. The forward fuselage was a welded chrome-molybdenum steel-tube structure with detachable metal panels.





Despite Finland's acceptance of the Russian peace terms on September 4, 1944, work on the prototype Pyörremyrsky, which had reached an advanced stage of construction, was continued although there was now no likelihood of the fighter entering quantity production. The prototype was flown for the first time early in 1945, and flight trials proved the Pyörremyrsky to be extremely manoeuvrable and to possess an outstanding climb rate.

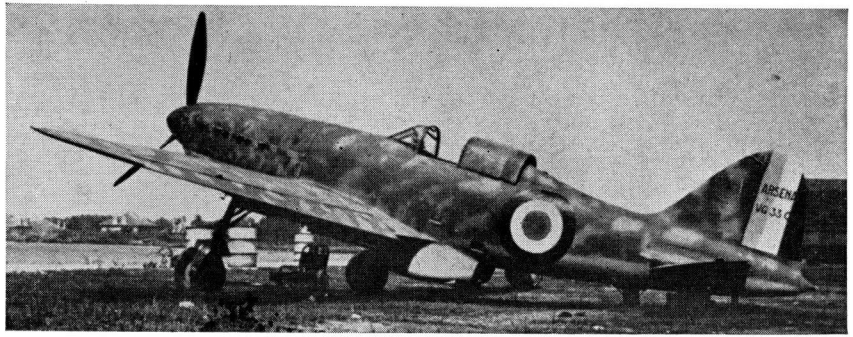
Type: *Single-seat Interceptor Fighter and Fighter-bomber.* **Power Plant:** *One* 1,475 *h.p. Daimler-Benz DB* 605*AC twelve-cylinder inverted-Vee liquid-cooled engine driving a V.D.M. controllable-pitch metal airscrew.* **Armament:** *One* 20-*mm. MG* 151 *cannon firing through the airscrew boss and two* 12.7-*mm. LKK*/42 *machine guns mounted in the upper decking of the fuselage nose. Attachment points for two* 440-*lb. bombs under wings.* **Performance:** *Maximum speed,* 404 *m.p.h.; climb to* 20,000 *ft.,* 4.8 *min.; service ceiling,* 37,500 *ft.; endurance,* 1.5 *hrs., with underwing drop tanks,* 2.5 *hrs.* **Weights:** *Empty,* 5,760 *lb.; normal loaded,* 7,280 *lb.; maximum,* 8,160 *lb.* **Dimensions:** *Span,* 34 *ft.* 1½ *in.; length,* 29 *ft.* 11½ *in.; height,* 12 *ft.* 9 *in.; wing area,* 204.514 *sq. ft.*

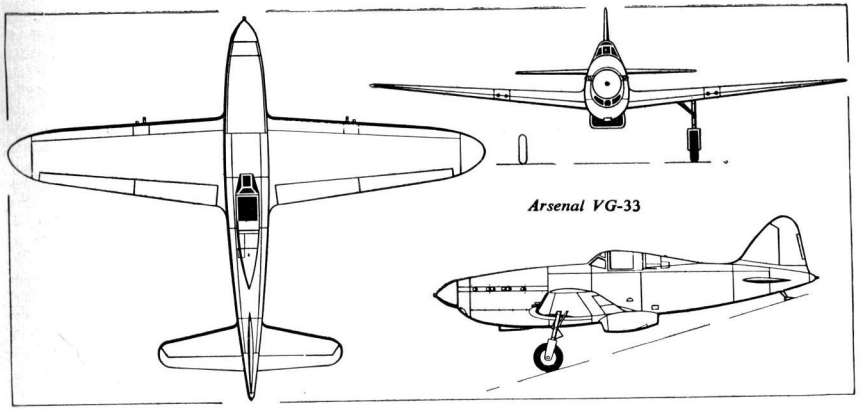
As a result of a specification for an M.S.406 replacement issued in 1937, four aircraft were developed to compete for quantity production orders: the D.520, the C.A.O.200, the M.S.450, and the VG-33. The last-mentioned fighter was the product of the Arsenal de l'Aéronautique and the design of Ingénieur-Général Vernisse, the director of the establishment, and M. Jean Galtier.

The VG-33 was derived directly from the VG-30, a lightweight fighter designed to compete with the Caudron C.713 Cyclone. A full-scale mock-up of the VG-30 was exhibited at the Exposition Internationale held in Paris in the summer of 1936, at which time it was proposed to power the fighter by a 610 h.p. Potez 12-Dc air-cooled twelve-cylinder horizontally-opposed engine. The non-availability of this power plant resulted in the installation of a liquid-cooled Hispano-Suiza 12Xcrs engine rated at 690 h.p., and with this engine the VG-30 made a successful initial flight at Villacoublay on October 1, 1938, with test pilot Vonner at the controls. The VG-30, which was considered primarily as a flying mock-up for a more powerful fighter, proved appreciably faster than the M.S.406 despite its low-powered engine. It was of all-wood, stressed-skin construction, had a wing area of 150.695 sq. ft., and a proposed armament of one 20-mm. Hispano-Suiza cannon and two 7.5-mm. MAC machine guns.

The first development of the VG-30 was the VG-31, in which it was proposed to install an 860 h.p. Hispano-Suiza 12Y-31 engine. The wing area of the VG-31 was to have been reduced to 129.167 sq. ft., but calculations revealed that the marginal increase in speed thus gained hardly warranted the poorer handling qualities and higher stalling speed that would result, and the VG-31 was not assembled, its wings being used for static tests and its

The VG-33 (below) was in production in May 1940, and 160 had reached various assembly stages.





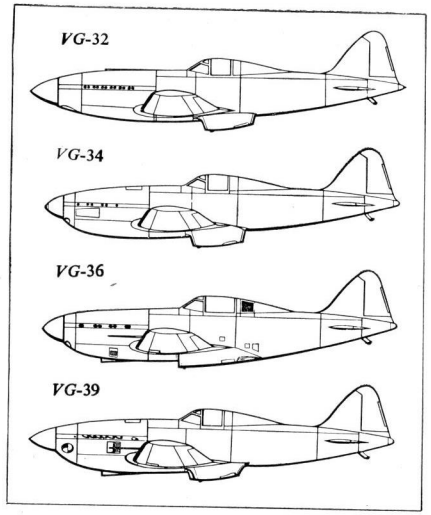
Arsenal VG-33

fuselage eventually being embodied in the VG-33-03. All subsequent developments retained the original 150.695 sq. ft. wing area.

The VG-32, which was, in fact, preceded by the VG-33, owing to delays in the delivery of its engine, was powered by a 1,040 h.p. Allison V-1710-C15 twelve-cylinder 60° Vee liquid-cooled geared and supercharged engine, but this prototype was not flown as, two weeks before its scheduled maiden flight, it was seized by German forces at Villacoublay.

The VG-33 was powered by an 860 h.p. Hispano-Suiza 12Y-31 engine driving a Chauvière-375 airscrew, and carried an armament of one 20-mm. cannon and four 7.5-mm. machine guns with a Baille-Lemaire 40 gun sight. The internal tankage housed 88 Imp. gal. of fuel; but provision was made for the attachment of two fixed 22 Imp. gal. external fuel tanks mounted under the wings, outboard of the guns. Construction was all-wood, and the two-spar, one-piece wing carried hydraulically-operated flaps. The VG-33-01 was flown for the first time in the late spring of 1939, and was handed over to the Centre d'Essais du Matérial Aérien for official trials at Villacoublay on August 11, 1939. During these trials, the VG-33 attained a speed of 347 m.p.h. at 17,060 ft.

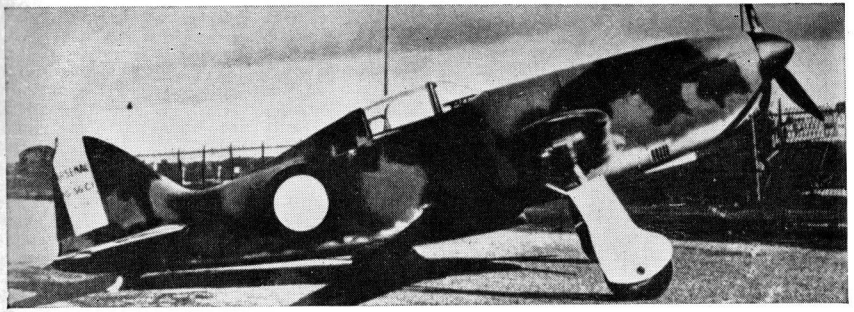
It was proposed to fit the VG-33-02 with a 910 h.p. Hispano-Suiza 12Y-45 engine but, although built, this aircraft was never assembled, its wings being married to the fuselage of the VG-31 to form the VG-33-03, and its fuselage being incorporated in the VG-34. The VG-33-03 was sent as a production prototype to the Chantiers Aéro-Maritimes de la Seine at Sartrouville, that factory having been awarded a production contract for 200 VG-33s a few weeks after the Munich Crisis, prior



to the prototype's initial flight. In the event, of the 160 VG-33s which had reached various stages of assembly at Sartrouville when German forces occupied the Paris area in June 1940, only a dozen could be flown from Villacoublay, and these were placed in storage by the Vichy Air Force at Châteauroux, where they were discovered by the Germans in November 1942.

The VG-34 with the Hispano-Suiza 12Y-45 engine was successfully flown during the spring of 1940, attaining a maximum speed of 358 m.p.h. at 21,325 ft. The VG-35 was a study for the installation of a 1,100 h.p. Hispano-Suiza 12Y-51 engine which was eventually installed in the VG-36. The latter had a deepened rear fuselage with a shallower ventral radiator, but the prototype completed only a few hours in the air. The VG-37 was a further design study employing a proposed 1,000 h.p. Hispano-Suiza engine which did not materialise, and the VG-38 was intended to use the Hispano-Suiza 77 with two Brown-Boveri exhaust-driven turbo-superchargers.

The VG-39 (below) was the definitive development.



The VG-36 (above) had a deeper rear fuselage, a shallower radiator and an H.S. 12Y-51 engine.

The final design development was the VG-39 with a 1,280 Hispano-Suiza 89ter engine and a modified wing structure which, retaining the 150.695 sq. ft. area, incorporated a new armament of six 7.5-mm. MAC 1934 M 39 machine guns. Externally the fuselage was similar to that of the VG-33, and during flight tests, abbreviated by the advance of the German forces, a maximum speed of 388 m.p.h. was achieved at 18,865 ft. The VG-39 prototype was eventually flown to Toulouse-Blagnac by Vonner, and the proposed production model, the VG-39bis, was to have embodied the modified fuselage of the VG-36 with the shallower radiator. Initial production aircraft were to have had the Hispano-Suiza 89ter engine and an armament of one 20-mm. cannon and six 7.5-mm. machine guns, and later models were to have carried a similar armament but were to have had the 1,600 h.p. Hispano-Suiza 12Z engine.

The proposed production model of the VG-32 was to have employed the VG-36 fuselage and the VG-39 wings, but armament was to have been restricted to six 7.5-mm. machine guns owing to the inability of the Allison V-1710-C15 engine to take the 20-mm. cannon. The SNCAN factory at Meaulte and the Couzinet factory at La Roche-sur-Yon were intended to participate in the VG-fighter series production programme, but tooling at these plants had not commenced at the time of the French collapse.

The specification relates to the VG-33.

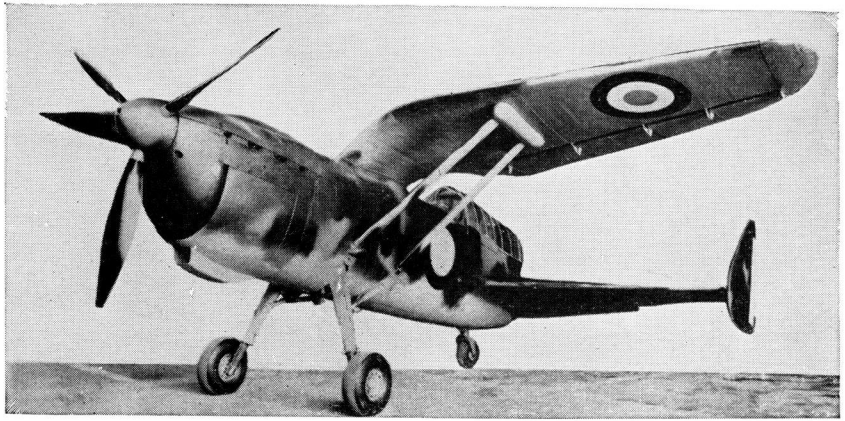
Type: *Single-seat Fighter.* **Power Plant:** *One* 860 *h.p. Hispano-Suiza* 12*Y*-31 *twelve-cylinder upright Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Hispano-Suiza HS*-404 *cannon with* 60 *rounds and four* 7.5-*mm. MAC* 1934 *M* 39 *machine guns.* **Performance:** *Maximum speed,* 347 *m.p.h. at* 17,060 *ft.; range, internal fuel,* 745 *mls., with auxiliary tanks* 1,100 *mls.; service ceiling,* 36,090 *ft.* **Weights:** *Empty,* 4,519 *lb.; normal loaded,* 5,856 *lb.; maximum,* 6,393 *lb.* **Dimensions:** *Span,* 35 *ft.* 5¼ *in.; length,* 28 *ft.* 4⅛ *in.; height (tail up),* 10 *ft.* 10⅛ *in.; wing area,* 150.695 *sq. ft.*

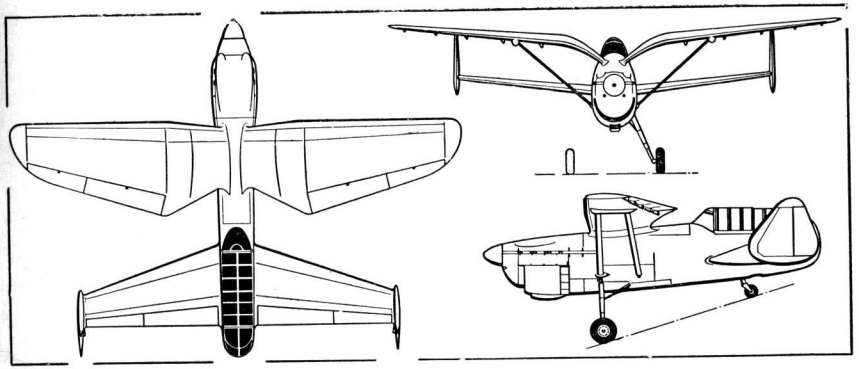
ARSENAL-DELANNE 10

FRANCE

In 1936, M. Delanne first proposed the use of the tandem-monoplane or Nénadovich biplane configuration for a military aircraft. The tandem-mounted wings providing a continuous slot effect were claimed to offer an exceptional c.g. travel and an extremely low stalling speed, and, to prove the claims made for this configuration, the Société Anonyme Française de Recherches Aéronautiques built a light tandem two-seat monoplane, the Delanne 20, powered by a 180 h.p. Régnier R6 engine. Unfortunately, this aircraft was destroyed on its first test flight, on August 10, 1938, but a second Delanne 20 was built and successfully test-flown in March 1939.

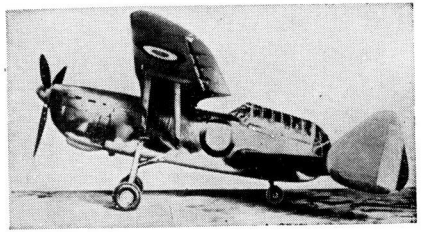
As the feasibility of the tandem-monoplane arrangement had now been proven, the S.A.F.R.A. furnished, at the request of the Ministère de l'Air, the Arsenal de l'Aéronautique at Villacoublay with full details of the configuration, and the Arsenal commenced the construction of a unique two-seat fighter, the Arsenal-Delanne 10. Apart from the use of slots on the leading edge of the forward wing, the fighter followed closely the configuration of the Delanne 20. Metal stressed-skin construction was employed, the fighter using for the first time a technique known as "contre-plaqué-métallique"—a smooth dural skin electrically welded to corrugated sheet. An unusual feature of the design for the period was the fact that the wheel well doors closed once the mainwheels had been extended in order to preserve the airflow over the lower





fuselage. The pilot was seated aft of the 132 Imp. gal. fuel tank, and the gunner, who faced rearwards, had an exceptional field of vision.

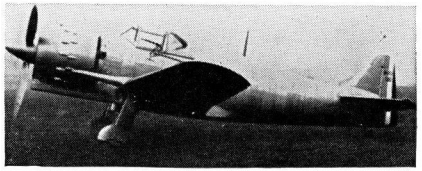
The Arsenal-Delanne 10 prototype had just been completed when Villacoublay was occupied by German forces in June 1940, and the Reichsluftfahrtministerium ordered the French personnel to continue work on the machine. After protracted delays during taxi-ing tests, and modifications to the vertical surfaces and tailwheel, the Arsenal-Delanne 10 finally flew for the first time in October 1941. The undercarriage was successfully retracted on the second flight, and some fifteen test flights were made from Villacoublay during which six hours in the air were logged. After the completion of these trials, the fighter was ferried to a German experimental centre for further tests, but its subsequent history is unknown.



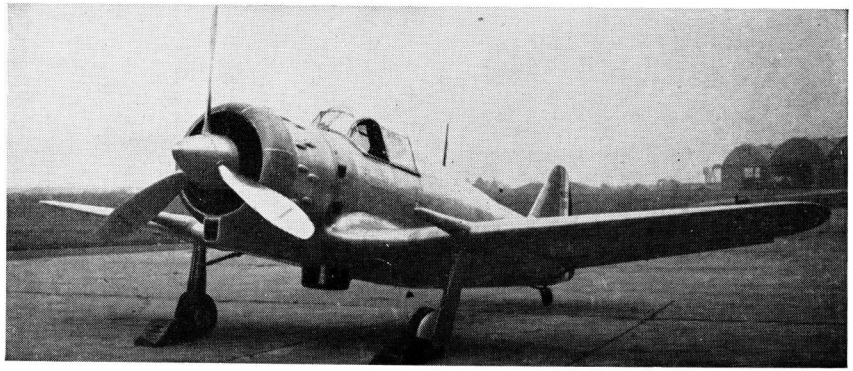
Type: *Two-seat General-purpose Fighter.* **Power Plant:** *One* 860 *h.p. Hispano-Suiza* 12 *Ycrs twelve-cylinder liquid-cooled engine.* **Armament** (*Proposed*): *One engine-mounted* 20-*mm. Hispano-Suiza cannon and two wing-mounted and two flexible* 7.5-*mm. MAC* 1934 *machine guns.* **Performance:** *Maximum speed,* 342 *m.p.h. at* 14,764 *ft.; time to* 16,400 *ft.,* 6.5 *min.; service ceiling,* 32,810 *ft.; endurance* (95% *power*), 1.5 *hrs.* **Dimensions:** *Span,* 33 *ft.* 2 *in.; length,* 24 *ft.* 0½ *in.; height,* 9 *ft.* 10 *in.; wing area,* 242.188 *sq. ft.*

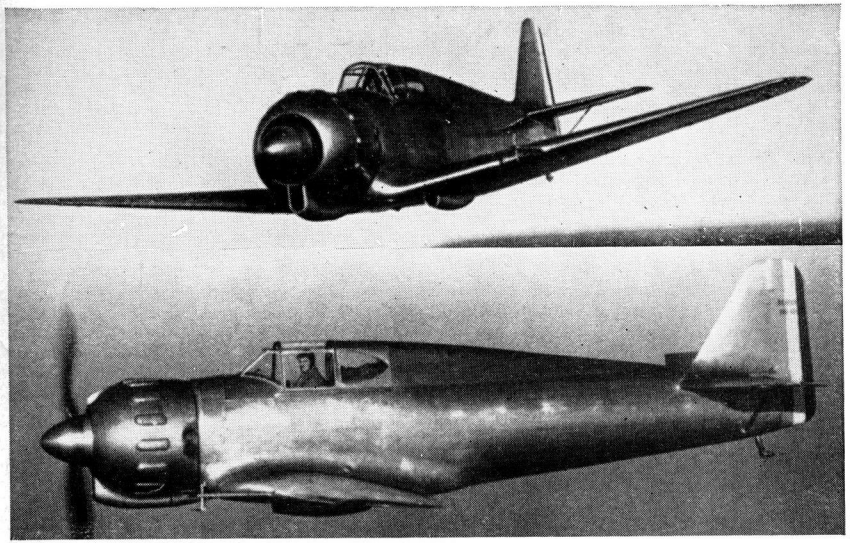
One of the prototypes produced to meet the French Air Ministry's July 1934 fighter specification which resulted in the Loire 250, the Dewoitine D.513, the Nieuport 161 and the M. S. 405, was an all-metal stressed-skin monoplane designed by M. Roussel and built at the Courbevoie plant of Avions Marcel Bloch. Designated MB-150-01, the prototype was powered by a direct-drive Gnôme-Rhône 14Kfs air-cooled radial engine rated at 930 h.p. at 14,435 ft., and had provision for an armament of two Hispano-Suiza HS-404 cannon. The first take-off of the prototype, construction of which had commenced in November 1935, was attempted on July 17, 1936, but this proved abortive, the aircraft failing to leave the ground. In the meantime, the Morane-Saulnier fighter had been designated winner of the contest, this fact, together with the failure of initial trials, resulting in the shelving of the MB-150.

Early in 1937, development of the MB-150 was resumed. A strengthened wing of greater area (165.764 sq. ft.) was fitted; the original Bloch undercarriage was supplanted by a taller Messier undercarriage, and a direct-drive Gnôme-Rhône 14No engine of 940 h.p. was installed. In this form the MB-150-01



(*Below and left*) *The Bloch* 150-01 (*modified*).





(*Above*) *The Bloch MB*-151 *No.* 1, *the first pre-production machine with close-fitting cowling.*

flew for the first time in October 1937 at Villacoublay. Official trials at the CEMA (Centre d'Essais du Matériel Aérien) began early in December 1937, and during these the maximum speed attained was 269.5 m.p.h. At the beginning of 1938, the wingtips were extended, increasing the wing span from 32 ft. 10¾ in. to 33 ft. 2¾ in., the twin wing-mounted oil radiators were replaced by a single radiator between the wheel wells, and a geared Gnôme-Rhône 14N7 engine was fitted. Trials were resumed in February 1938, and on the strength of these, two months later, a pre-production batch of twenty-five MB-150 fighters was ordered and a tentative order placed for a further 475 machines.

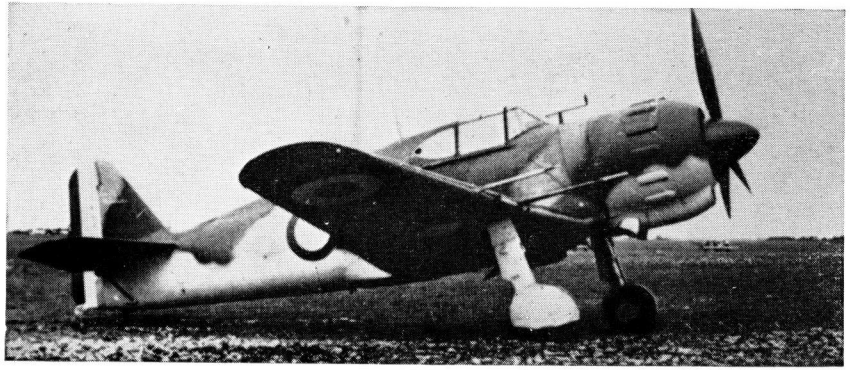
In the meantime, Avions Marcel Bloch had been absorbed by the Société Nationale de Constructions Aéronautiques de Sud-Ouest (SNCASO) and the newly-constructed Châteauroux-Déols plant of the SNCASO began work on the pre-production MB-150 fighters

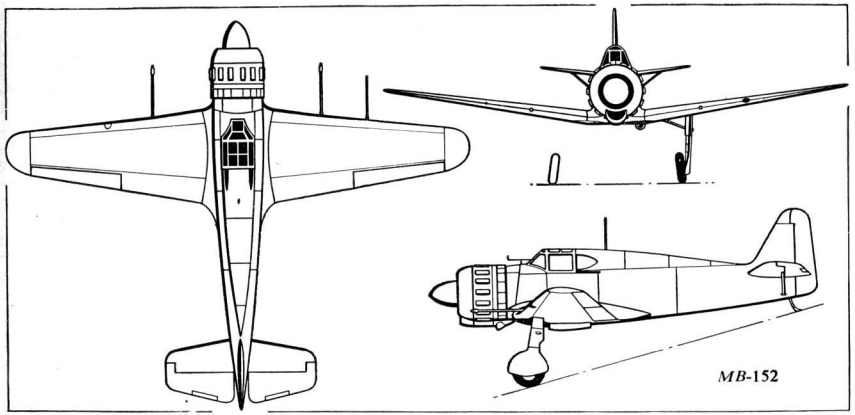
in May 1938. It was soon discovered that the structure of the fighter was unsuited for rapid mass-production, and an extensive structural redesign was therefore undertaken. Simultaneously the wing profile was modified and the wing area reduced to 161.243 sq. ft., and a Gnôme-Rhône 14N-11 engine rated at 920 h.p. at 12,140 ft. was installed and enclosed by a long-chord, close-fitting cowling with an unusually small diameter intake for the cooling air. The modified fighter was designated MB-151, and the prototype, the MB-151-01 built at Courbevoie, flew for the first time on August 18, 1938 at Villacoublay. Armament comprised four wing-mounted 7.5-mm. MAC 1934 machine guns with 300 r.p.g., and firing trials took place at Cazaux in November 1938.

While work on the twenty-five pre-production MB-151s proceeded at Châteauroux-Déols, a further development of the basic design, the MB-152, was completed at Courbevoie. Differing from the MB-151 essentially in having a 1,030 h.p. Gnôme-Rhône 14N-21 engine, the MB-152-01 flew for the first time in December 1938, and, re-engined with a 1,080 h.p. Gnôme-Rhône 14N-25, began official trials at the CEMA in February 1939. A firm order was now placed for 400 machines, of which 60 were to be MB-151s and the remainder MB-152s.

Production was slow in starting, only four pre-production MB-151s, the first of which having flown in December 1938, being delivered by April 1939, but the SNCASO plant at Bordeaux-Mérignac was brought into the production programme, and delivery tempo increased rapidly. An unlimited production order for MB-152s was placed with the SNCASO at the outbreak of war, but on

A production Bloch MB-152. Five Groupes de Chasse were operational on the MB-152 on May 10, 1940.





September 3, 1939, of the 120 MB-151s and MB-152s delivered, ninety-five possessed no airscrews and the remainder lacked gunsights. Delays in the supply of the Gnôme-Rhône airscrews—later replaced by Chauvière-371 airscrews—and Baille-Lemaire GH-38 gunsights seriously interfered with the service introduction of the fighters. However, an Escadrille d'Expérimentation was formed at Orléans-Bricy in September 1939, and deliveries to the Groupes de Chasse began in the following month, but teething troubles delayed operational use, and of the 358 delivered by the end of November, 157 still lacked airscrews.

The production MB-151s were powered by the Gnôme-Rhône 14N-35 engine rated at 920 h.p. at 9,840 ft., and the MB-152s were initially powered by the G-R 14N-25 rated at 1,080 h.p. for take-off and 1,000 h.p. at 11,810 ft., but MB-152s subsequent to No. 300 received the slightly more powerful G-R 14N-49. Cooling difficulties necessitated an increase in the diameter of the engine air intake orifice and the introduction of an auxiliary intake to cool the rear face of the engine. Some of the MB-151s had two of the MAC 1934 machine guns replaced by two 20-mm. HS-404 cannon, and the MB-152s had an interchangeable armament of four MAC 1934 machine guns with 500 r.p.g. or two machine guns and two 20-mm. HS-404 cannon with 60 r.p.g. The rudder trim tab was initially adjustable on the ground only, but on MB-152 No. 641 and subsequent machines the trim tab was adjustable in flight.

MB-152 No. 434 was taken from the production line and fitted with a Pratt and Whitney R-1830 Twin Wasp engine as the MB-153-01, this prototype being destroyed in May 1940 when its pilot failed to avoid a bomb crater

while landing at Villacoublay. The MB-154 was a proposed version powered by a Wright R-1820 Cyclone engine, but no prototype of this variant was completed.

Once the teething troubles of the MB-151 and MB-152 had been overcome they were generally considered to be excellent combat aircraft. They made steady gun platforms, their sturdy structures were capable of absorbing considerable battle damage, they possessed excellent manoeuvrability, high diving speeds, and their handling characteristics were pleasant.

Groupe de Chasse I/1 was the first unit to convert to the MB-151 in October–November 1939, and Groupes II/1, III/9, II/10, and III/10 as well as the Naval shore-based Escadrille AC-3 were flying MB-151s or MB-152s before the end of the year. Early in 1940, nine MB-151s were supplied to the Royal Hellenic Air Force, and at the commencement of the German offensive on May, 10 1940, the air formations at the disposal of France's Northern Command included Groupes I/1, II/1 and III/10 equipped with MB-152s and II/10 with MB-151s. The Eastern Command included I/8 and II/8 with MB-152s, and the Alps Command had Groupe III/9 with MB-151s and II/9 in process of conversion to MB-152s. Groupe II/6 converted to MB-152s after the beginning of the offensive.

With the Franco-German Armistice production terminated with MB-152 No. 699. The range of the MB-151 and MB-152 was inadequate to permit any fighters of these types to be ferried to North Africa, and with the formation of the Vichy Air Force in Unoccupied France six Groupes de Chasse were permitted to retain their MB-151s and MB-152s by the German Armistice Commission. These were GC I/1 (Lyon-Bron), GC II/1 (Le Luc), GC I/8 (Montpellier), GC II/8 (Marignane), GC II/9 (Clermont-Ferrand-Aulnat), and GC III/9 (Salon-de-Provence).

The short range of the Bloch fighters occasioned considerable concern among the Vichy Groupes de Chasse in view of the ever-present possibility of German occupation of the whole of France, and therefore a 15 Imp. gal. auxiliary tank was secretly designed and manufactured in 1941 at Argenton-sur-Creuse. This tank, installed in the rear fuselage, augmented the main fuel tank sufficiently to enable the Bloch fighters to cross the Mediterranean to North Africa if necessary. During the late months of 1941 and the early months of 1942, a small team, dodging agents of the Abwehr, visited the Bloch-equipped Groupes de Chasse, modifying some ninety-five machines. This activity was discovered by the Germans, however, and Commandant Rousseau-Dumarcet, who had originally requested the tanks, was relieved of his command by the Vichy government. During 1942, GC I/1, II/1 and III/9 were re-equipped with Dewoitine D.520s, and their MB-151s and MB-152s were passed to the Rumanian Air Force.

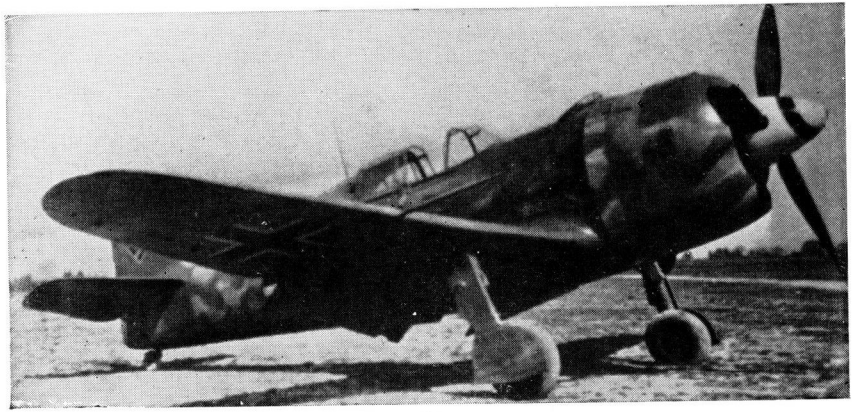
In the following specification data quoted in parentheses relates to the MB-152.

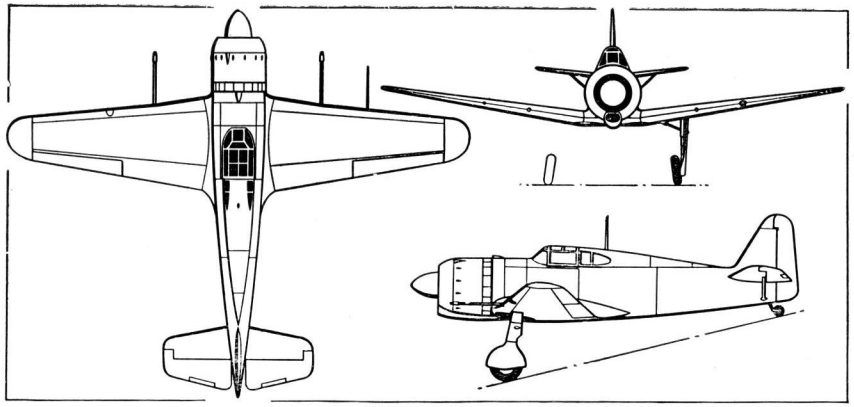
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 920 *h.p. Gnôme-Rhône* 14*N*-35 (1,080 *h.p. G-R* 14*N*-25 *or* 1,100 *h.p. G-R* 14*N*-49) *fourteen-cylinder air-cooled radial engine.* **Armament:** *Four* 7.5-*mm. MAC* 1934 *M* 39 *machine guns with* 300 *r.p.g.* (500 *r.p.g.*) *or two* 7.5-*mm. MAC* 1934 *M* 39 *machine guns and two* 20-*mm. Hispano-Suiza* 404 *cannon with* 60 *r.p.g.* **Performance:** *Maximum speed,* 301 *m.p.h.* (320 *m.p.h.*) *at* 13,120 *ft.*, (299 *m.p.h. at* 18,040 *ft.*); *maximum cruising speed,* 280 *m.p.h.*; *climb to* 16,400 *ft.*, 7 *min.* (6 *min.*); *service ceiling,* 32,800 *ft.*; *range,* 398 *mls.* (373 *mls.*) *at* 18,040 *ft.* **Weights:** *Empty,* 4,374 *lb.* (4,453 *lb.*); *maximum loaded,* 5,706 *lb.* (5,908 *lb.*). **Dimensions:** *Span,* 34 *ft.* 7 *in.*; *length,* 29 *ft.* 10¼ *in.*; *height,* 12 *ft.* 11⅞ *in.*; *wing area* 161.243 *sq.ft.*

BLOCH MB-155

Towards the end of 1939, the Société Nationale de Constructions Aéronautiques de Sud-Ouest (SNCASO) began the development of a single-seat fighter which, embodying many of the components of the MB-152, would offer a higher speed, greater range and smaller turning radius than its predecessor. Designated MB-155, the fighter was developed under the direction of M. Fandeux, and at the beginning of 1940, a modified MB-152 began flight trials at Châteauroux-Déols, serving as a prototype for the new fighter. The modified aircraft featured an enlarged and cleaner engine cowling and a slight increase in the wing chord. Flight trials with the experimental aircraft were successful, and production of the MB-155 was initiated at Châteauroux-Déols in May 1940.

Utilizing most of the jigs and tools employed for the MB-152, the MB-155 retained the Gnôme-Rhône 14N-49 which drove a three-blade electric Ratier airscrew, but in order to increase internal fuel capacity, the cockpit was moved aft, necessitating a major structural redesign of the fuselage. The main wing





structure and undercarriage were identical to those of the MB-152. The MB-155 was the first French production fighter to feature belt-fed cannon and an armoured windshield, the latter consisting of 40-mm. Triplex glass. Two MB-155s were destroyed on June 18, 1940, when the Châteauroux-Déols facilities were bombed and strafed by the Luftwaffe, the twelfth MB-155 being readied for delivery on that day, and some twenty additional machines being in advanced stages of assembly.

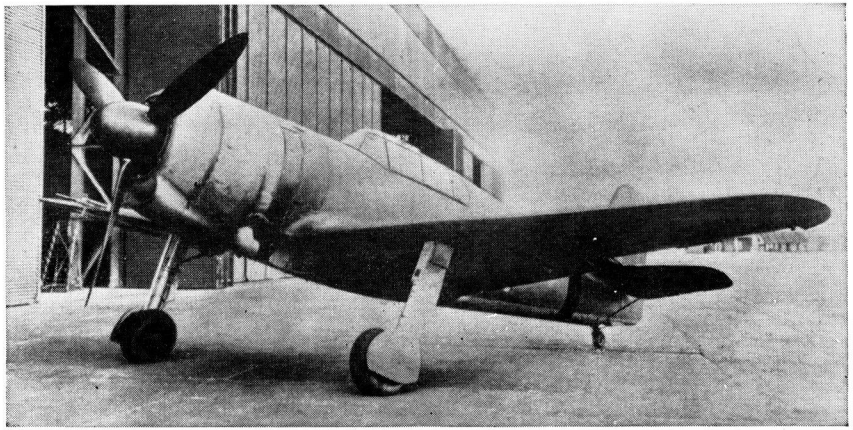
MB-155 fighters were about to be delivered to GC I/1 at Agen, but the capitulation of June 25th prevented this. Production of the MB-155 was halted but, with the withdrawal of the German forces to the line of demarcation, the machines remaining on the assembly line were completed and subsequently delivered to the Groupes de Chasse of the Vichy Air Force which operated them alongside MB-151s and MB-152s. When most of the Groupes converted to the Dewoitine D.520 in 1942, all existing MB-155s were gathered together and handed to the Groupe de Chasse I/8 based at Montpellier. With the disbandment of the Vichy French forces on November 27, 1942, the MB-155 fighters were seized by the Luftwaffe.

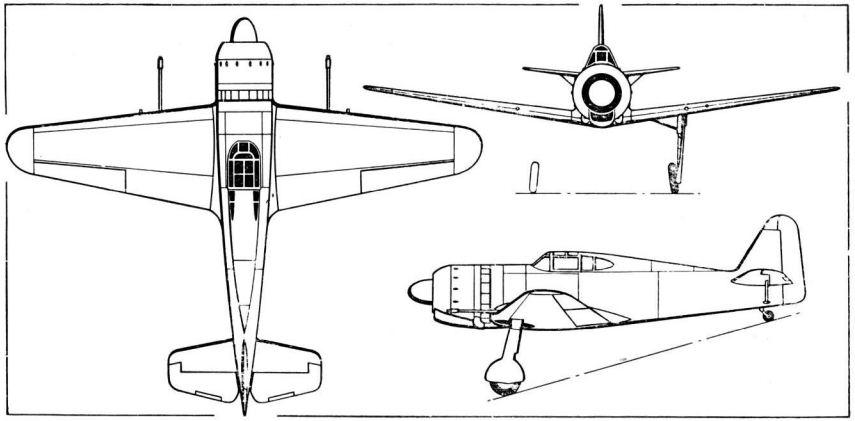
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,100 *h.p. Gnôme-Rhône* 14*N*-49 *fourteen-cylinder air-cooled radial.* **Armament:** *Two* 20-*mm. Hispano-Suiza* 404 *cannon and two* 7.5-*mm. MAC* 1934 *M* 39 *machine guns or six* 7.5-*mm. machine guns.* **Performance:** *Maximum speed,* 323 *m.p.h. at* 18,040 *ft.*; *range,* 652 *mls. at* 18,040 *ft.*; *service ceiling,* 32,800 *ft.* **Weights:** *Empty,* 4,630 *lb.*; *loaded,* 6,393 *lb.* **Dimensions:** *Span,* 34 *ft.* 7 *in.*; *length,* 29 *ft.* 8⅓ *in.*; *height,* 12 *ft.* 11⅞ *in.*; *wing area,* 186.43 *sq. ft.*

BLOCH MB-157 FRANCE

Designed by M. Lucien Servanty and the last of the line of fighters stemming from the Bloch MB-150 of 1936, the MB-157 was a singularly outstanding fighter deserving of a fate far better than that for which it was destined. When the new Gnôme-Rhône 14R air-cooled radial engine appeared in 1939, the SNCASO considered its installation in an MB-152 airframe under the designation MB-156. It was soon discovered that this marriage would be difficult to accomplish owing to the weight of the new engine, and as the power plant was worthy of a cleaner airframe in order to take full advantage of the 1,700 h.p. that it offered, it was decided to design an entirely new fighter which would retain the structural principles of the earlier MB-152.

Design work proceeded rapidly, and construction of a prototype MB-157 was initiated at Villacoublay in December 1939. The Gnôme-Rhône 14R-4 engine installed in the prototype MB-157 offered 1,590 h.p. for take-off, 1,700 h.p. at 26,250 ft., and a cruising output of 1,400 h.p., and it was proposed that an armament of two 20-mm. Hispano-Suiza cannon and four 7.5-mm. machine guns should be housed in the wings. By the time the prototype components were ready for assembly, German forces were approaching Paris. Therefore, on June 9, 1940, they were loaded on a trailer which was to be towed to Poitiers, but the trailer was captured by a German column and ordered to the SNCASO establishment at Bordeaux-Mérignac in the occupied zone





of France. The completion of the aircraft was authorized by the German authorities, and the prototype MB-157 was flown for the first time in March 1942, minus armament.

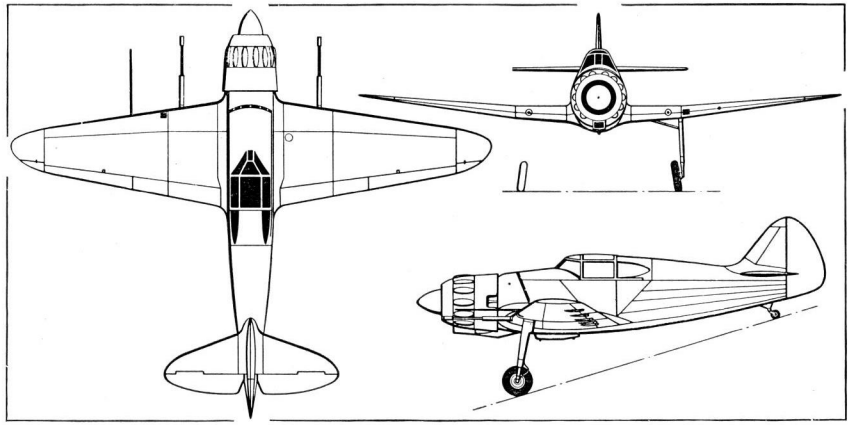
Flight trials were extremely successful, and during the first weeks of 1943 the Germans ordered the MB-157 to be ferried to Orly. To the amazement of the Luftwaffe personnel at Orly, the MB-157 landed there forty minutes ahead of the scheduled time given by the Mérignac control! At Orly, the MB-157 was deprived of its power plant, which was tested in the Hispano-Suiza wind tunnel at Bois-Colombes and subsequently shipped to Germany. The airframe remained in one of the two Orly airship hangers, where it was later destroyed in an Allied air raid. The MB-157 was an extremely advanced fighter for its time, possessing a performance attained by piston-engined fighters only during the closing stages of the war.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,580 *h.p. Gnôme-Rhône* 14*R*-4 *fourteen-cylinder air-cooled radial.* **Armament:** *Two* 20-*mm. Hispano-Suiza HS*-404 *cannon and four* 7.5-*mm. MAC* 1934 *M* 39 *machine guns.* **Performance:** *Maximum speed,* 441 *m.p.h. at* 25,750 *ft.,* 416 *m.p.h. at* 27,890 *ft.; climb to* 26,250 *ft.,* 11 *min.; cruising speed,* 248 *m.p.h.; range,* 680 *mls. at* 19,685 *ft.; endurance,* 1.5 *hrs. at* 70% *power.* **Weights:** *Empty,* 5,265 *lb.; normal loaded* 7,165 *lb.* **Dimensions:** *Span,* 35 *ft.* 1½ *in.; length,* 31 *ft.* 9¾ *in.; height,* 10 *ft.* 6 *in.; wing area,* 208.819 *sq. ft.*

BLOCH MB-700 FRANCE

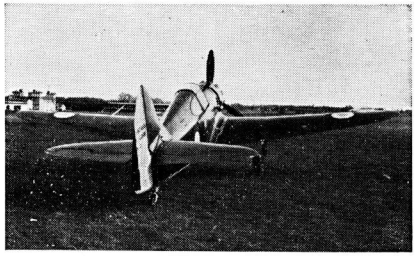
During the late 'thirties, the French Air Ministry began to consider the use of non-strategic materials, particularly tropical timbers, for combat aircraft construction as a safeguard against any shortage of steel and light alloys in the event of war. A specification was issued for a single-seat fighter of wooden construction, and to meet this requirement, M. André Herbemont, who had previously designed all SPAD types produced after 1918, prepared the MB-700. Conceived and built at the former Blériot-Aéronautique works at Suresnes which had been incorporated in the SNCASO when the French aircraft industry was nationalised in 1937, the MB-700-01 was flown first on April 19, 1940 at Buc.

The MB-700 was of all-wood, stressed-skin construction, the wing being a one-piece, two-spar structure with fuel tanks with a total capacity of 77 Imp. gal. between the spars, and the fuselage being covered by moulded plywood forward and fabric aft. For its relatively low power (700 h.p.), the MB-700 had an excellent performance, but the prototype



had only completed a dozen hours in the air when Buc airfield was occupied by German forces. For some unexplained reason, the MB-700-01 was not ferried to safety before the arrival of the enemy forces, and the Germans, evidently believing the prototype to be booby-trapped, promptly burnt the machine.

At the time of France's collapse, M. Herbemont's team was working on a shipboard development of the basic design, the MB-720.

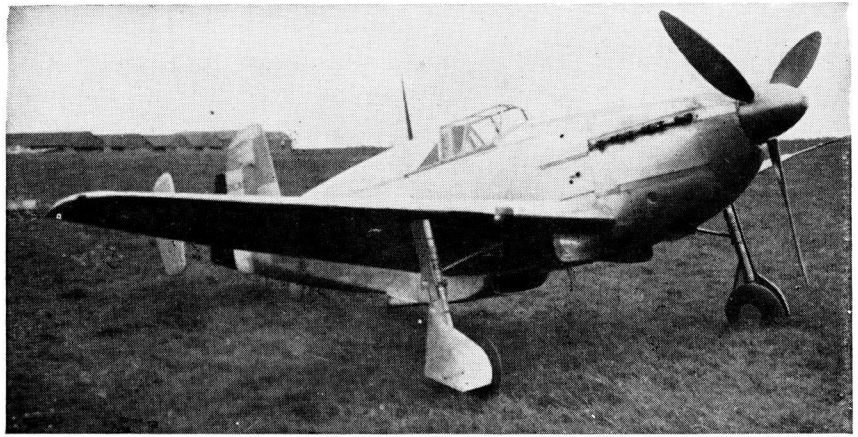


Type: *Single-seat Light Interceptor Fighter* **Power Plant:** *One* 700 *h.p. Gnôme-Rhône* 14*M*6 *fourteen-cylinder air-cooled radial engine.* **Armament** (*proposed*): *Two* 20-*mm. Hispano-Suiza HS*-404 *cannon and two* 7.5-*mm. MAC* 1934 *M*39 *machine guns mounted in the wings, or four wing-mounted* 7.5-*mm. M*39 *machine guns.* **Performance:** *Maximum speed,* 342 *m.p.h. at* 13,120 *ft.; endurance,* 2 *hrs.* **Weights:** *Loaded* (*with four machine guns*), 3,858 *lb.,* (*with two cannon and two machine guns*), 4,078 *lb.* **Dimensions:** *Span,* 19 *ft.* 7½ *in.; length,* 16 *ft.* 2⅛ *in.; height,* 5 *ft.* 6 *in.; wing area,* 133.472 *sq. ft.*

C.A.O. 200 FRANCE

The C.A.O. 200, produced by the Société Nationale de Constructions Aéronautiques de l'Ouest (S.N.C.A.O.) at the former Nieuport works at Issy-les-Moulineaux, was designed by M. Marie of the former Nieuport design team and was, in fact, a progressive development of the earlier Nieuport Ni-161 fighter designed to the same specification as the Morane-Saulnier M.S.405. Produced to compete with the Dewoitine D.520, and exhibited as a full-scale mock-up during the 1938 Salon de l'Aéronautique, the C.A.O. 200 was designed to take the Hispano-Suiza 12Y-51 engine rated at 1,100 h.p. at 2,500 r.p.m. at 10,695 feet, but the prototype, which flew for the first time on January 31, 1939 at Villacoublay, was fitted with the Hispano-Suiza 12Y-31 rated at 830 h.p. for take-off and 860 h.p. at 2,400 r.p.m. at 10,660 ft. With this engine the C.A.O. 200 was somewhat underpowered.

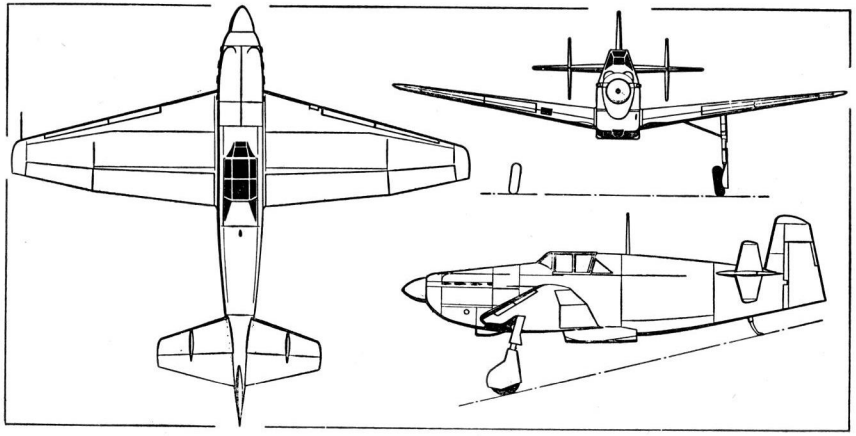
The structure of the C.A.O. 200 made extensive use of electric welding. The single-piece wing possessed a single metal girder structure with metal stressed-skin covering. The forward fuselage was constructed of electrically-welded steel tubes with detachable duralumin panels, and the rear section was a duralumin monocoque. Leading-edge wing slats were interconnected with the trailing-edge flaps, opening automatically when the flaps were lowered 40°, and the incidence of the tailplane could be varied.



During flight trials several modifications were made. The leading-edge slats were modified to open when the flaps were lowered 32°, auxiliary vertical surfaces were attached to the tailplane, and ejector exhaust stubs were fitted, the thrust augmentation provided by these increasing maximum speed by 10 m.p.h.

The prototype had flown thirty hours when it was handed over to the CEMA (Centre d'Essais du Matériel Aérien) in August 1939. Official trials were successful but the Dewoitine D.520 had already been ordered into quantity production. Nevertheless, work on an evaluation batch of twelve C.A.O. 200 fighters powered by the H.S. 12Y-51 engine began but, in the event, none of these was completed before France's collapse. With the H.S. 12Y-51 engine it was anticipated that the C.A.O. 200 would attain 380 m.p.h. at 18,045 ft. The prototype C.A.O. 200 was returned to the S.N.C.A.O. to supplement Villacoublay's defences, but there is no record of this aircraft seeing action.

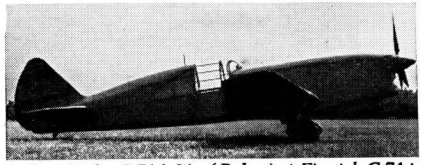
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 860 *h.p. Hispano-Suiza* 12 *Y*-31 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Hispano-Suiza* 404 *cannon firing through the airscrew hub, and two wing-mounted* 7.5-*mm. MAC* 1934 *machine guns.* **Performance:** *Maximum speed,* 277 *m.p.h. at sea level,* 304 *m.p.h. at* 13,120 *ft.,* 332 *m.p.h. at* 15,090 *ft.,* 342 *m.p.h. at* 19,685 *ft.; time to* 6,560 *ft.,* 2 *min.* 27 *sec., to* 13,120 *ft.,* 4 *min.* 50 *sec., to* 19,680 *ft.,* 7 *min.* 50 *sec.; service ceiling,* 36,090 *ft.; endurance,* 2 *hrs.* **Weights:** *Loaded,* 5,511 *lb.* **Dimensions:** *Span,* 31 *ft.* 2 *in.; length,* 29 *ft.* 2⅛ *in.; height,* 11 *ft.* 5½ *in.; wing area,* 143.16 *sq. ft.*



CAUDRON C.714

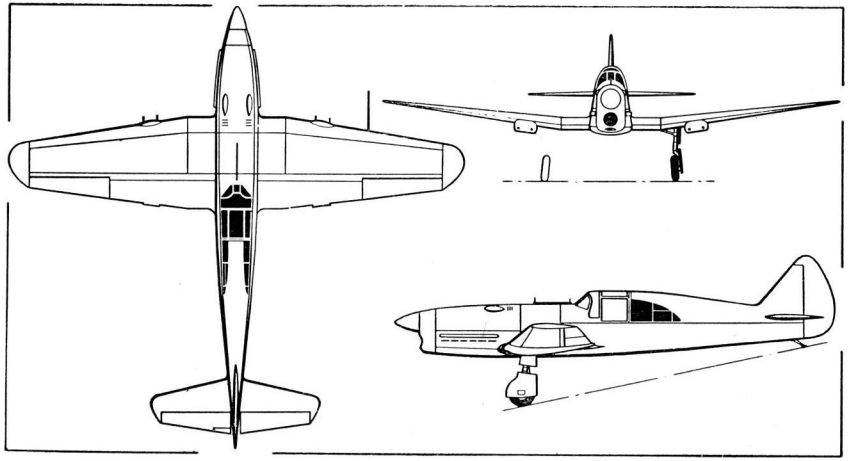
FRANCE

The Caudron C.714 was one of the few true lightweight fighters to attain production status during World War II. The C.714 was evolved indirectly from the experimental C.710 fighter inspired by the small racing aircraft which competed in the 1933–35 Coupe Deutsch de la Meurthe. Designed by Marcel Riffard, the C.710-01 first flew on July 18, 1936 with a 450 h.p. Renault 12Ro1 engine and an armament of two 20-mm. cannon. The C.711 racing monoplane did not materialise, and the C. 712R was designed for an attempt on the World Air Speed Record and flew on December 24, 1936, but the next model, the C.713 Cyclone, was a further lightweight fighter, differing from the C. 710 primarily in having a fully retractable undercarriage and redesigned vertical tail.



(*Above*) *The C.*714-01. (*Below*) *A Finnish C.*714.

The C.713 Cyclone was first flown at Guyancourt in December 1937, and the C.714, which appeared the following summer, was essentially similar but embodied a strengthened fuselage and a wing of improved profile. The C.714-01 underwent official trials at the CEMA (Centre d'Essais du Matériel Aérien) from September to October 1938, during which dives up to 435 m.p.h. were performed. In November 1938, the wing-mounted armament



of four 7.5-mm. machine guns was installed and, simultaneously, one hundred machines were ordered.

Production commenced in the summer of 1939, the airframes being built by a Renault factory known as "Usine-O" in the Paris suburb of Le Point-du-Jour. The C.714 called for only 5,000 man-hours in its construction, and comprised a one-piece, two-spar wooden wing and a wooden fuselage with light alloy, fabric-covered control surfaces. The Armée de l'Air decided that the fighter's climb performance was inadequate by contemporary standards, and production was terminated after the delivery of the ninetieth machine in February 1940. Fifty were diverted to Finland but only six reached the Finnish Air Force, the remainder being lost en route. The first all-Polish unit to be formed in France, the Groupe de Chasse I/145, was equipped with the C.714 for a brief period, and saw some combat over the Rouen-Dreux area, June 1940.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 450 *h.p. Renault* 12*RoI twelve-cylinder air-cooled inverted-Vee engine.* **Armament:** *Four* 7.5-*mm. MAC* 1934 *M* 39 *machine guns.* **Performance:** *Maximum speed,* 302.5 *m.p.h. at* 13,120 *ft.*; *climb to* 13,120 *ft.*, 6.75 *min.*; *service ceiling,* 29,855 *ft.*; *range,* 559 *mls. at* 199 *m.p.h.* **Weights:** *Empty,* 3,086 *lb.*; *loaded,* 3,858 *lb.* **Dimensions:** *Span,* 29 *ft.* 5 *in.*; *length,* 27 *ft.* 11¾ *in.*; *height,* 9 *ft.* 5 *in.*; *wing area,* 134.549 *sq. ft.*

CAUDRON-RENAULT C.R.760

FRANCE

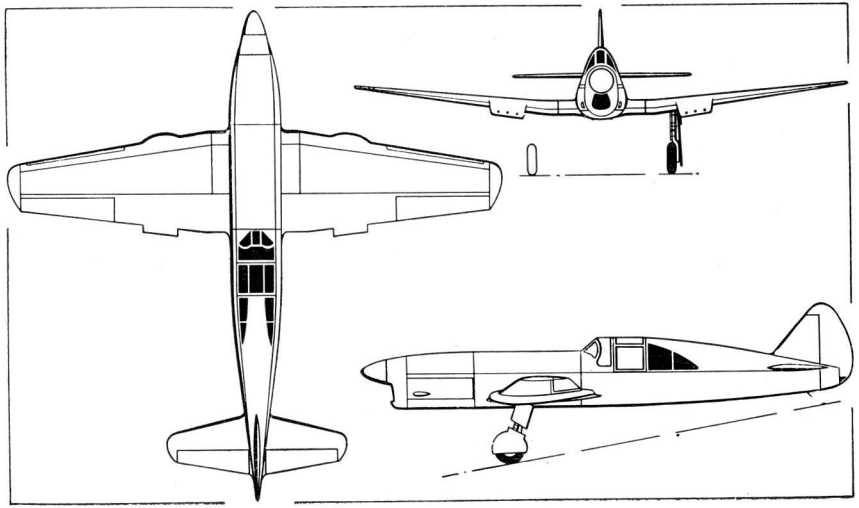
During 1938 the Ministère de l'Air issued a specification for a lightweight fighter suitable for mass-production by sub-contractors outside the aircraft industry, and making the greatest possible use of non-strategic materials. At this time Caudron was testing the C.713 Cyclone lightweight fighter and completing the prototype C.714, and the C.715 designed to meet the performance requirements of the new specification was based on the latter but was powered by an Italian Isotta-Fraschini Delta RC.40 air-cooled engine offering some 300 h.p. more than the Renault engine of the C.714. Although it was originally proposed to install a supercharged Renault engine in the new fighter, the non-availability of this power plant necessitated the acquisition of a manufacturing licence for the Isotta-Fraschini.

While still on the drawing board, the designation of the new fighter was changed from C.715 to C.R.760. Pre-assembled elements were employed in the C.R.760's construction. The wing comprised two wooden box spars with wooden ribs and a stressed plywood skin, and carried electrically-actuated leading-edge slots in magnesium alloy, and electrically-actuated light-alloy fabric-covered split flaps. The fuselage was a welded steel-tube structure with moulded dural skinning. An 86 Imp. gal. fuel tank was housed in the fuselage between the firewall and the forward bulkhead of the cockpit, and the main undercarriage members were retracted hydraulically. The armament of six machine guns was housed in two trays attached to the undersurfaces of the wings, outboard of the undercarriage wells, with 300 r.p.g. The ammunition compartments were later extended towards the wingtips to increase the number of rounds per gun to 1,200, 1,500 and ultimately 3,000.

Three C.R. 760 prototypes were built, the C.R.760-01 and -02 commencing flight trials at Guyancourt at the beginning of 1940, tests being conducted by the Caudron-Renault chief test pilot, Raymond Delmotte, assisted by the Isotta-Fraschini test pilot Ferrarin. Tests proved the C.R.760 to possess a phenomenal performance for the power available. It was also extremely manoeuvrable and simple to maintain. Both machines were at Orléans-Bricy when the German forces approached the airfield, and were destroyed to prevent them falling into German hands.

The third C.R.760 airframe was completed as the C.R.770-01.

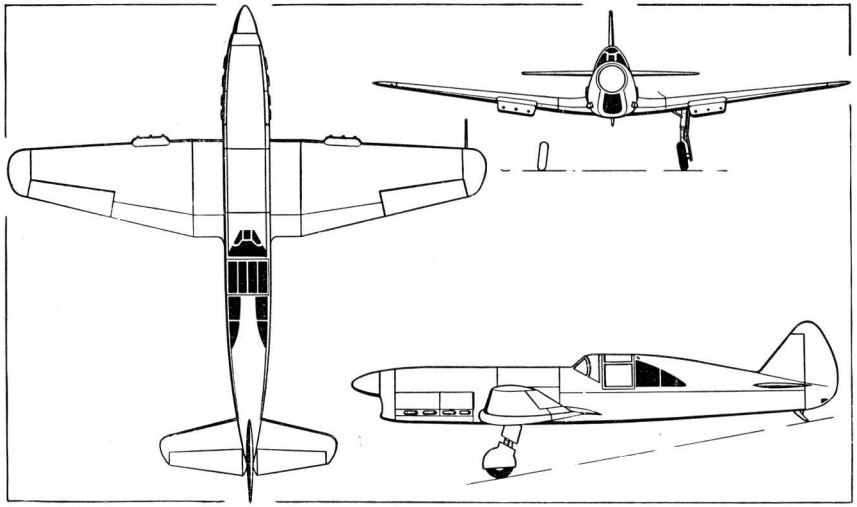
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 730 *h.p. Isotta-Fraschini Delta R.C.*40 *twelve-cylinder inverted-Vee air-cooled engine.* **Armament:** *Six* 7.5-*mm. MAC* 1934 *M* 39 *machine guns mounted in trays attached to the wings outboard of the undercarriage.* **Performance:** *Maximum speed,* 285 *m.p.h. at sea level,* 354 *m.p.h. at* 16,400 *ft.; initial climb rate,* 2,600 *ft./min.; time to* 13,120 *ft.,* 5 *min.; service ceiling,* 33,800 *ft.; endurance,* 3 *hrs.* 10 *min. at* 298 *m.p.h. at* 13,120 *ft.,* 1 *hr.* 30 *min. at* 95% *power.* **Weights:** *Empty,* 3,179 *lb.; normal loaded,* 4,092 *lb.* **Dimensions:** *Span,* 29 *ft.* 5⅛ *in.; length,* 29 *ft.* 2 *in.; height,* 9 *ft.* 6⅛ *in.; wing area,* 134.549 *sq. ft.*

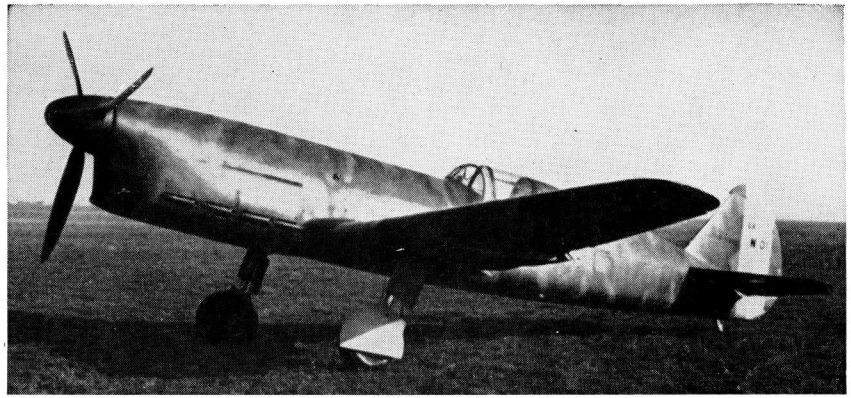


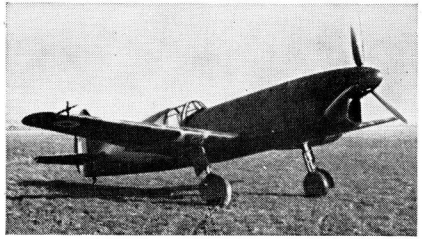
CAUDRON-RENAULT C.R.770 FRANCE

Although the Renault company had purchased manufacturing licences for the Isotta-Fraschini Delta and Zeta air-cooled engines, at the beginning of 1940, M. Louis Renault decided to proceed with the development of a new sixteen-cylinder air-cooled inverted-Vee engine to replace the Renault 12Ro1 which, installed in the C.714 fighter, offered insufficient power to provide that aircraft with a contemporary performance. Within the remarkably short period of fifty days, the new engine, the Renault 626 which employed many 12Ro1 components, ran for the first time. Although very little bench-running had been completed with the new power plant, it was installed in the C.R.760-03 airframe which, with a new wing, became the C.R.770-01. The fuselage and tail assembly were identical with those of the C.R.760.

The first and only flight of the C.R.770 took place at Guyancourt in May 1940 with Raymond Delmotte at the controls. Ten minutes after take-off the Renault 626's long crankshaft broke, but Delmotte succeeded in landing the prototype safely. The hastily constructed engine had been provided with insufficient







bearings, and the necessary changes were being made when the Wehrmacht approached the Paris area. As the prototype had no engine and could not, therefore, be flown to safety, it was destroyed.

A further development of the Caudron-Renault series of lightweight fighters, the C.R.780, was planned at the time of France's capitulation. This, powered by a 500 h.p. Renault 468 twelve-cylinder inverted-Vee air-cooled engine and carrying an armament of two 20-mm. Hispano-Suiza 404 cannon and two or four 7.5-mm. machine guns, was expected to attain a maximum speed of 331 m.p.h. at 12,000 ft.

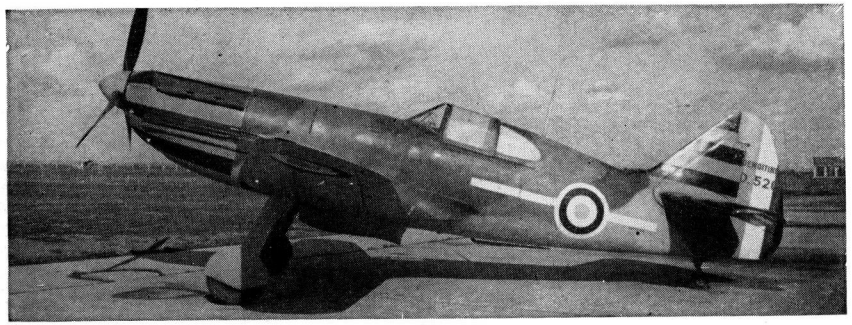
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 800 *h.p. Renault* 626 *sixteen-cylinder inverted-Vee air-cooled engine.* **Armament:** *Six* 7.5-*mm. MAC* 1934 *M* 39 *machine guns.* **Performance:** *Maximum speed,* 367 *m.p.h. at* 14,765 *ft.,* 278 *m.p.h. at sea level; initial climb rate,* 2,420 *ft./min.; time to* 13,120 *ft.,* 4 *min.* 16 *sec.; service ceiling,* 33,960 *ft.; endurance,* 3 *hrs.; range,* 932 *mls.* **Weights:** *Empty,* 3,836 *lb.; loaded,* 4,740 *lb.* **Dimensions:** *Span,* 28 *ft.* 6 *in.; length,* 32 *ft.* 6 *in.; height,* 9 *ft.* 7 *in.; wing area,* 134.5 *sq. ft.*

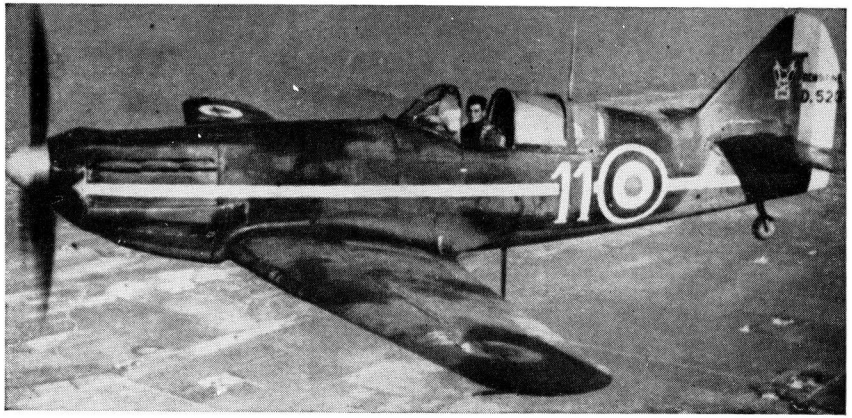
DEWOITINE D.520 FRANCE

The D.520 was designed by a team led by Emile Dewoitine at the Société Nationale de Constructions Aéronautiques du Midi to meet an official specification issued in 1937 and calling for a single-seat fighter eventually to be equipped with the 1,100 h.p. Hispano-Suiza 12Y-51. Primarily responsible for the new fighter were Engineers Vautier, Castello and Rey, and the first of three prototypes, the D.520-01, flew on October 2, 1938 at Toulouse-Francazals with Marcel Doret at the controls.

The D.520-01 was powered by an H.S.12Y-21 engine which, rated at 890 h.p. for take-off, drove a two-bladed wooden fixed-pitch airscrew. Leading-edge slots were fitted initially, but these were found to be unnecessary and were removed for the second phase of the flight trials, for which a three-bladed airscrew was fitted. During these trials, which were delayed by damage resulting from a wheels-up landing in November 1938, it was discovered that the radiators, which were submerged in the wings, limited maximum speed to 298 m.p.h. Thus, the D.520-02, flown in January 1939, featured a ventral fuselage radiator, and in order to rectify some instability the vertical tail surfaces were enlarged. On February 8, 1939, while being tested at Francazals by Léopold Galy, a speed of 513 m.p.h. was attained in a dive, and two days later the D.520-02 was ferried to the CEMA (Centre d'Essais du Matériel Aérien) at Villacoublay where it was joined by the D.520-03, this third prototype having redesigned vertical tail surfaces and an H.S. 12Y-31 rated at 830 h.p. for take-off. It was proposed to re-engine the D.520-02 with a 1,100 h.p. H.S. 12Y-51.

CEMA trials were completed satisfactorily at the beginning of March 1939, and a contract for 200 machines was placed with the S.N.C.A. du Midi, the contract calling, somewhat optimistically, for the delivery of ten machines in the following September, thirty in October, sixty in November, and 100 in





December. Production commenced at Toulouse-Blagnac, an order for a further 400 D.520 fighters being placed in June 1939, but the first machine off the assembly line, the D.520 No. 1, did not fly until November 2, 1939. The D.520 No. 1 could not be considered as the first production machine, however, for it retained the H.S. 12Y-31 engine, carried two drum-fed 7.5-mm. machine guns in housings under the wings, and had a curved, one-piece windshield and tail skid.

The first true production machine, the D.520 No. 2, was powered by a 910 h.p. H.S.12Y-45 engine with a Szydlowski supercharger and a Ratier-1606M electric airscrew. Armament comprised an engine-mounted 20-mm. cannon and four belt-fed 7.5-mm. guns. A tailwheel was fitted and the windscreen incorporated an optically-flat panel. The wing was a single-spar structure with duralumin skinning and fabric-covered ailerons and pneumatically-operated flaps. The fuselage was an all-metal monocoque.

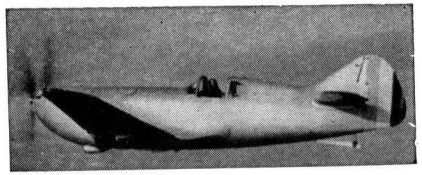
The Groupe de Chasse I/3 was the first unit to receive the D.520, and was allocated the task of eliminating the fighter's teething troubles. The D.520 proved exceptionally popular with service pilots, who enjoyed the sensitiveness of its controls, the simplicity of its instrument panel, and the ease with which it recovered from a spin.

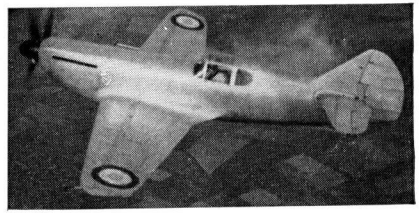
By May 1940, the S.N.C.A. du Midi's Toulouse-Blagnac plant had attained a monthly production rate of 100 machines (an output of ten per day being reached during the following month), but on May 10th, only GC I/3 was operational on the D.520. However, GC II/3 converted to the new fighter between May 9th and 18th, and soon joined combat. These units were joined by GC III/3, GC III/6, and GC II/7 before June 25, 1940, and the Franco-German armistice, the D.520s being officially credited with 114 confirmed "kills" and 39 "probables". A naval unit, 1° Flottille de Chasse, was re-equipped with the D.520 and joined combat before the armistice, and GC II/6 and GC III/7 had converted to the type but were too late to see action. Between the 18th and 20th of June, GC I/3, II/3, III/3, III/6, and II/7 flew their aircraft to North Africa.

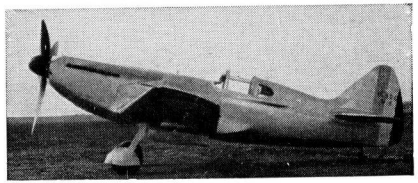
By June 24, 1940, D.520 No. 411 had left the assembly line, and preparations were being made for the mass production of a variant of the basic fighter, the D.521. The D.521 was powered by a Rolls-Royce Merlin III rated at 1,030 h.p. at 16,250 ft. and 990 h.p. at 12,250 ft. Armament comprised two wing-mounted 20-mm. Hispano-Suiza cannon, but only a prototype of the D.521 was tested. One machine, the D.520Z, was fitted with an H.S. 12Z engine and was flown twice before June 25, 1940.

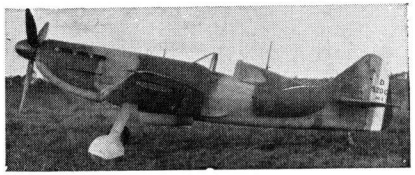
Although production of the D.520 was terminated by the armistice, development of the basic design continued in secret, one project being the M.520T (M indicating Midi) which was to have been powered by a 1,200 h.p. Hispano-Suiza 12Z-89ter engine with which a maximum speed of 405 m.p.h. was anticipated at 22,470 ft. By the spring of 1941 the S.N.C.A. du Midi had been absorbed by the S.N.C.A. du Sud-Est, the Vichy Air Force had adopted the D.520 as its standard fighter, and the German Armistice Control Commission had authorised the resumption of D.520

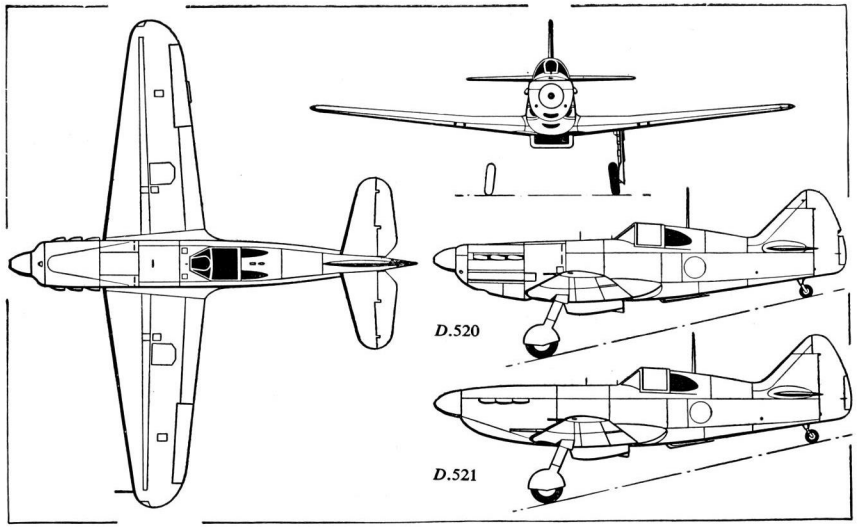
(Right, top to bottom) The D.520-01, *the D.*520-02, *the* D.520 *No.* 1 *and the D.*520 *No.* 2.











production at Toulouse-Blagnac. In 1942, the D.520 No. 465 was flown with an improved H.S.12Y-45 engine, a modified radiator and inboard hinged wheel doors, and by October 1942, nine Vichy Groupes de Chasse were operating the D.520, as well as the 1° Flottille de Chasse. These had seen some action against British forces in the Levant and had escorted Vichy bombers in an attack on Gibraltar on September 24, 1940.

With the German invasion of Unoccupied France in November 1942, and the disbanding of the French armed forces, the D.520s of the various Groupes de Chasse, and those stored at the Bases de Stockage or awaiting delivery at Blagnac, were seized by the Luftwaffe, this service equipping two fighter-trainer units, J.G.103 and J.G.105, with the type, supplying the Regia Aeronautica with sixty machines which were used primarily as fighter-trainers by Gruppi 13, 22, 24 and 167, and issuing about one hundred to the Bulgarian Air Force and others to the Rumanian Air Force. Of the Axis countries, only Bulgaria and Rumania employed the D.520 operationally.

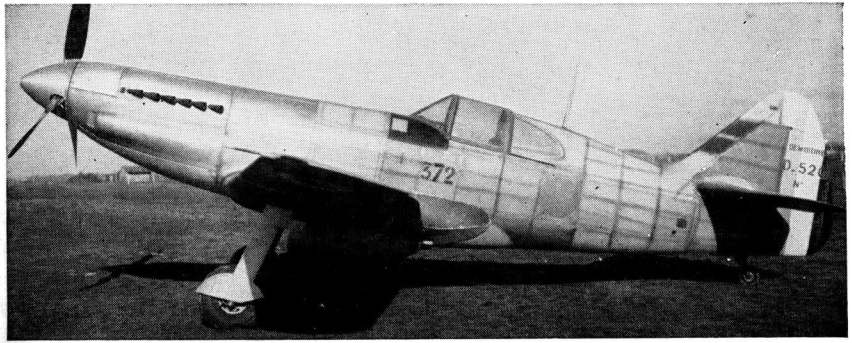
Limited production of the D.520 continued

after the German invasion of Unoccupied France, and in February 1943 a further H.S.12Z-powered version of the fighter, the S.E.520Z, was flown for the first time. The S.E.520Z attained a maximum speed of 409 m.p.h. at 30,020 ft. on the 1,600 h.p. of an Hispano-Suiza 12Z which featured direct fuel injection. An elongated reduction gearbox permitted very clean nose contours, and loaded weight was 7,011 lb. The proposed armament comprised three 20-mm. cannon and two 7.5-mm. machine guns, but only one was completed.

When German forces evacuated Toulouse on August 22, 1944, S.N.C.A. de Sud-Est and former Armée de l'Air personnel seized all airworthy D.520s and those undergoing overhaul and, on September 16th, formed Groupe de Chasse I/8 under Marcel Doret, strafing the retreating German columns and attacking German pockets at Royan, Pointe de Grave, Rochefort and Oléron. One hundred and eighty D.520 fighters had been produced subsequent to the resumption of production after the armistice, bringing total production to approximately 610 machines.

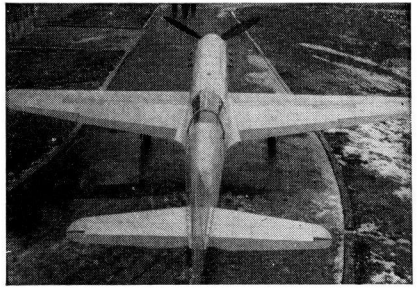
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 910 *h.p. Hispano-Suiza* 12 *Y*-45 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Hispano-Suiza* 404 *cannon with* 60 *rounds and four* 7.5-*mm. MAC* 1934 *M* 39 *machine guns with* 500 *r.p.g.* **Performance:** *Maximum speed,* 329 *m.p.h. at* 19,685 *ft.,* 280 *m.p.h. at sea level; cruising speed,* 248 *m.p.h.; maximum cruising speed,* 310 *m.p.h. at* 90% *power at* 13,120 *ft.; initial climb rate,* 2,362 *ft./min.; time to* 13,120 *ft.,* 4 *min.; service ceiling,* 36,090 *ft.; normal range,* 620 *mls.; maximum range,* 777 *mls.* **Weights:** *Empty,* 4,608 *lb.; maximum loaded,* 6,129 *lb.* **Dimensions:** *Span,* 33 *ft.* 5½ *in.; length,* 28 *ft.* 8½ *in.; height,* 8 *ft.* 5 *in.; wing area,* 171.684 *sq. ft.*

The S.E. 520*Z* (*below*) *was first flown in February* 1943, *and attained a maximum speed of* 409 *m.p.h.*

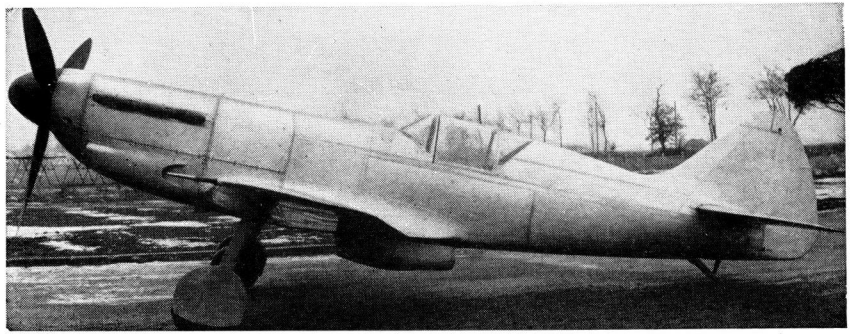


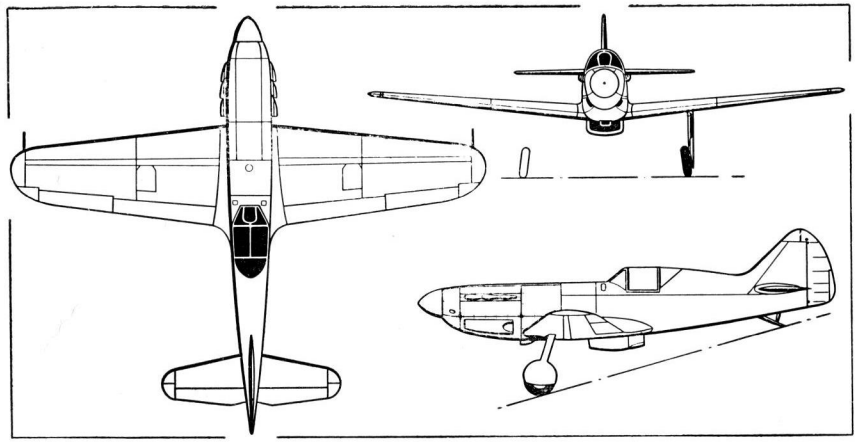
DEWOITINE D.551 FRANCE

At Toulouse-Francazals on June 23, 1939, Marcel Doret flew the Dewoitine D.550 for the first time. This aircraft was designed for an attempt on the World Air Speed Record, and initial trials were conducted with an Hispano-Suiza 12Y engine boosted to 1,300 h.p., the prototype attaining 436 m.p.h. at 19,685 ft. with this engine on November 22, 1939. The advent of the Second World War prevented the development of the special 1,800 h.p. engine with which the boosted H.S.12Y was to have been replaced, but the potentialities of the basic design prompted the SNCAM staff to evolve a fighter variant, the D.551.

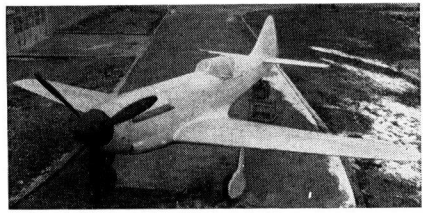


The D.551 possessed a fuselage essentially similar to that of the D.550, but internal fuel capacity was increased and a cockpit canopy similar to that of the D.520 was fitted. A 1,100 h.p. H.S.12Y-51 engine with a hub-mounted cannon was installed and the wing's area was increased from the D.550's 96.875 sq. ft. to 118.4 sq. ft., and accommodated four belt-fed machine guns. All-metal construction was employed, and the design was particularly suited for mass production. A one-piece, single-spar wing and monocoque fuselage were employed, and the control surfaces were fabric-covered. The tail skid was fully retractable.





Sixteen pre-production D.551 fighters were ordered by the French Air Ministry in the spring of 1940 prior to the prototype's first flight, but only the prototype, two pre-production machines and ten fuselages were completed before the Franco-German Armistice, and very few flight tests had been completed by June 25, 1940, after which the German Armistice Commission forbade any further trials.



Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,100 *h.p. Hispano-Suiza* 12*Y*-51 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Hispano-Suiza* 404 *cannon and four* 7.5-*mm. MAC* 1934 *M* 39 *machine guns.* **Performance:** *Maximum speed,* 348 *m.p.h. at* 16,400 *ft.; time to* 13,120 *ft.,* 3.5 *min.* **Weights:** *Empty,* 3,794 *lb.; maximum loaded,* 4,740 *lb.* **Dimensions:** *Span,* 30 *ft.* 7⅛ *in.; length,* 26 *ft.* 10¾ *in.; height,* 9 *ft.* 2¾ *in.; wing area,* 118.4 *sq. ft.*

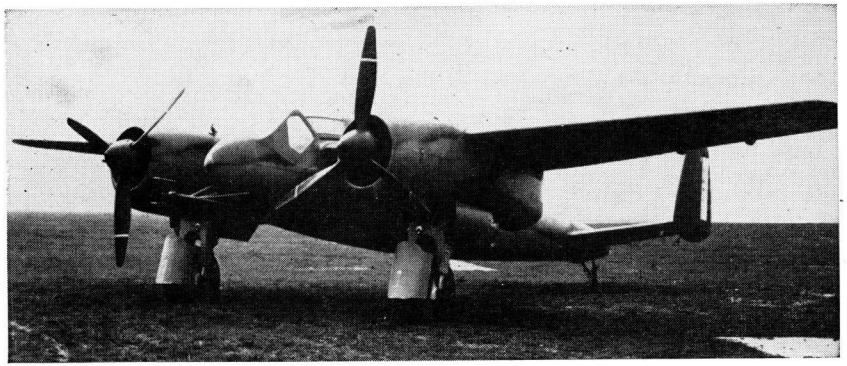
HANRIOT NC-600

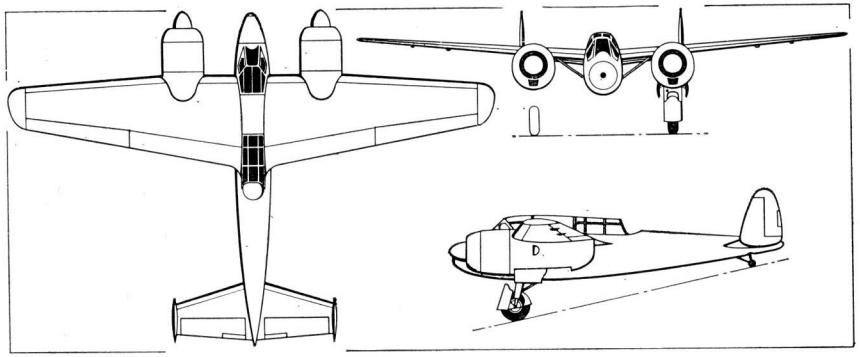
FRANCE

During the late 'thirties, the French aircraft industry was among the leading exponents of the twin-engined multi-purpose fighter, and was responsible for the development of several extremely promising warplanes in this category. Unfortunately for the Armée de l'Air, none of the designs prepared to meet the French Air Ministry's 1936 specification for a twin-engined fighter capable of undertaking the long-range escort, bomber interceptor, and attack roles, reached the assembly lines. This was partly the result of changes in official requirements which lengthened the gestatory periods of the aircraft concerned, and partly the result of vacillation in placing quantity production orders. One of the most promising twin-engined fighters to suffer in this way was the NC-600, produced by the Bourges plant of the Société Nationale de Constructions Aéronautiques du Centre (SNCAC) which had absorbed the Hanriot company under the Nationalisation Law.

The NC-600 was evolved from the experimental Hanriot H-220-1 twin-engined light fighter which, as the H-220 with twin 450 h.p. Renault 12Ro1 engines and a single fin and rudder assembly, was first exhibited at the International Aeronautical Exhibition in Paris, in 1936, having been designed to meet the requirements of a 1934 specification. Powered by Gnôme-Rhône radials and sporting a new twin fin-and-rudder tail assembly, the prototype was flown as the H-220-1 for the first time on September 2, 1937, but was destroyed during the following February. Externally, the H-220-2 differed little from the H-220-1, and in 1938 a batch of six machines was ordered for service evaluation under the new designation NC-600.

The NC-600 was of relatively advanced





conception and, in view of the limited power available from its twin air-cooled radial engines, attained a good performance. Basically a mid-wing semi-cantilever monoplane, the wings being braced to the fuselage sides by short parallel struts, with an oval monocoque fuselage, the NC-600 carried split trailing-edge flaps over its entire wing span, and the wing centre section housed four fuel tanks with a total capacity of 176 Imp. gal., an additional fuel tank being housed in the fuselage between the two cockpits. The whole aircraft was covered by smooth Védal stressed-skin, and the engines, which drove Ratier electric air-screws, were enclosed in low-drag cowlings.

The NC-600-01 (previously H-220-2) flew in 1939 at Bourges with the SNCAC chief test pilot, M. Haegeler, at the controls. It proved to possess an exceptional performance, although its low-speed handling characteristics left something to be desired. The NC-600-02 was completed and about to commence flight testing when the unorthodox SE-100, designed to meet the requirements of the same specification, was selected for quantity production, and the SNCAC plant at Bourges was instructed to tool up for the manufacture of the Bréguet 696 attack bomber. Thus further work on the NC-600 was abandoned.

Type: *Two-seat Long-range Escort and Attack Fighter.* **Power Plants:** *Two* 700 *h.p. Gnôme-Rhône M*0/01 *Mars fourteen-cylinder air-cooled radial engines.* **Armament:** *Two forward-firing* 20-*mm. Hispano-Suiza HS*-404 *cannon and one* 20-*mm. HS*-404 *cannon and two* 7.5-*mm. MAC machine guns firing aft.* **Performance:** *Maximum speed,* 337 *m.p.h. at* 16,400 *ft.; climb to* 26,250 *ft.,* 14 *min.; range,* 534 *mls. at* 302 *m.p.h.* **Weights:** *Empty,* 6,499 *lb.; loaded,* 8,818 *lb.* **Dimensions:** *Span,* 41 *ft.* 11¾ *in.; length,* 28 *ft.* 10½ *in.; height,* 10 *ft.* 3¼ *in.; wing area,* 227.764 *sq. ft.*

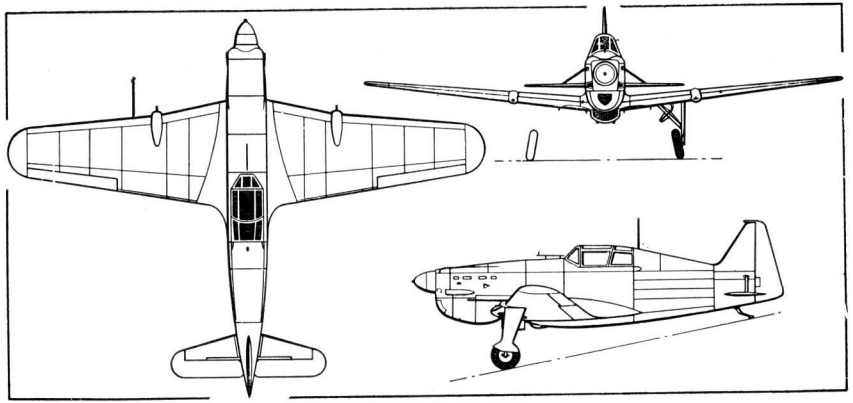
MORANE-SAULNIER M.S. 406 FRANCE

Numerically, the Morane-Saulnier was the most important fighter available to the Armée de l'Air at the commencement of the Second World War. Essentially the production version of the M.S.405 which had been designed to meet a specification issued in 1934, the M.S. 406 was a reliable aircraft with pleasant characteristics, but it had the misfortune to be out-classed by the fighters which it opposed.

The first prototype, the M.S.405-01, flew for the first time on August 8, 1935 with an Hispano-Suiza 12Ygrs engine. During official trials initiated at the CEMA (Centre d'Essais du Matériel Aérien) early in 1936, the aircraft attained speeds of 250 m.p.h. at sea level and 298 m.p.h. at 13,120 ft. The second prototype, the M.S.405-02, differed from its predecessor primarily in having a wing of revised planform and the improved Hispano-Suiza 12 Ycrs engine, and official trials with the prototypes were completed in July 1937.

A pre-production batch of fifteen machines had been ordered in August 1936, and the first of these, the M.S.405 No. 1, reached the CEMA by the end of January 1938. The M.S. 405 No. 3 was fitted with wing fuel tanks and the fuselage tank was replaced by a compartment for a dummy parachutist. In this form it was designated M.S. 407 LP (Lance-Parachute). The M.S.405 No. 4 was fitted with the 860 h.p. H.S. 12Y-31 engine later to be adopted for the production M.S.406, and the M.S.405 No. 12 differed from earlier machines in having a modified wing structure. The Plymax wing skinning (duralumin sheet bonded to plywood) had proved sufficiently strong to permit the elimination of several ribs, and this structure was standardised for the M.S.406.

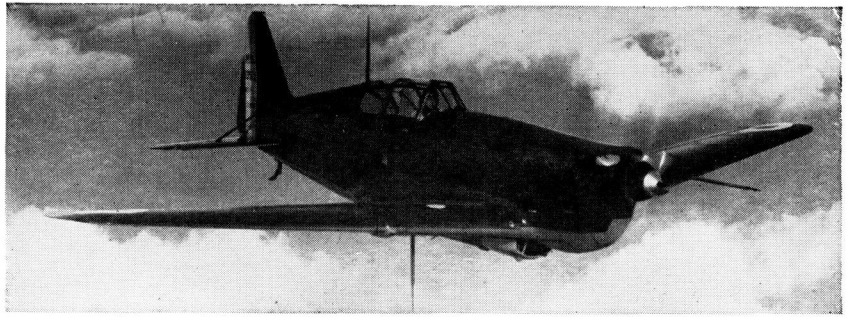
The M.S.405 was normally fitted with a



semi-retractable radiator, but M.S.405 No. 12, which was experimentally fitted with an H.S. 12Y-45 engine featured a non-retractable radiator, and was redesignated M.S.411 when it first flew with this modification on January 24, 1939. The M.S. 405 No. 13 was also fitted with a non-retractable radiator, and the inboard wing sections were modified to accommodate flare bays. These modifications, which resulted in a change of designation to M.S.408, were made at the request of the Swiss government which, in July 1938, had acquired a manufacturing licence for the fighter. The Swiss also purchased two M.S.405s which they designated D-3800, building eighty-two. A Swiss development, the D-3801, was manufactured by the Fabrique Fédérale d'Avions at Emmen and the Dornier-Werke A.G. at Altenrhein, and, featuring a non-retractable radiator, had a 1,000 h.p. Hispano-Suiza 12Y-S1 produced by Adolph Saurer. The D-3801 enjoyed a superior performance to French models, attaining a speed of 325 m.p.h. at 13,950 ft., and 207 were built.

The production version of the M.S.405 which incorporated all the modifications requested by the CEMA, was designated M.S.406, and 1,000 fighters of this type were ordered in March 1938, the first of these, M.S.406 No. 16, being assembled by the S.N.C.A.O. plant at Bouguenais and flown in June 1938. Production tempo attained six machines per day in April 1939 and eleven per day by the following September, terminating at Bouguenais late in 1939. A second assembly line had been started at Puteaux late in 1938, the first fighter from this line, M.S.406 No. 971, flying on January 29, 1939. Production continued at Puteaux until June 1940, terminating with the 1,037th machine (M.S.406 No. 1052).

At the beginning of the Second World War, the Armée de l'Air possessed four Escadres de



*The M.S.*405 *No.* 11 (*above*), *photographed in May* 1939, *one of the M.S.*406's *predecessors.*

*The M.S.*405-01 *with fixed undercarriage.*

Chasse (each comprising three Groupes of twenty-five aircraft) equipped with the M.S. 406, and several foreign governments had placed orders for the fighter. The Lithuanian government ordered twelve, although, in the event, these were not delivered, and forty-five M.S.406s were supplied to Turkey. The Polish government ordered 160, and the first batch of fifty of these was actually embarked for Gdynia in September 1939 but failed to reach its destination before Poland's collapse. Thirteen M.S.406s (without the standard 20-mm. HS-404 cannon) were shipped to China, but these were sequestered by the French Colonial Administration when they reached Haiphong, equipping Escadrille de Chasse 2/595 which was formed at Bach-Mai, Indochina, at the beginning of the war.

Thirty M.S.406s were ordered by Finland, these equipping the Finnish Air Force's 28th Squadron. After the French collapse Finland acquired fifty-seven captured M.S.406s from Germany, and most of these were re-engined by the Finnish State Aircraft Factory with captured Russian 1,100 h.p. Klimov M-105P engines, aircraft so modified being dubbed "Super-Moranes". The M-105P had the same dimensions and mounting points as the Hispano-Suiza 12Y-31, and was fitted with a two-stage, two-speed blower. The conversion programme was initiated in August 1943, and successful trials with an experimental model resulted in the decision to convert all available M.S.406s in a similar fashion. A 12.7-mm. Beresin gun fired through the airscrew hub and the wing-mounted 7.5-mm. guns were retained. Maximum speed was increased to 326 m.p.h., and initial climb rate and service ceiling were increased to 4,921 ft./min. and 39,370 ft. respectively. The "Super-Moranes"

began to reach operational squadrons in June 1944, and participated in the final stages of the Russo-Finnish conflict in Carelia.

M.S.406 No. 1005 was flown in December 1939 with a raised tailplane, and this same machine was subsequently employed to test the installation of two 32 Imp. gal. external fuel tanks. One hundred pairs of these tanks were ordered in March 1940, and some were later used by the Vichy government to ferry M.S.406s to the Levant in June 1941. M.S.406 No. 1028 received a strengthened wing housing four 7.5-mm. machine guns. The four guns were belt-fed and, replacing the two drum-fed guns previously fitted, resulted in the elimination of the bulged fairings on the wing leading edges. The modified aircraft, which was test flown first in May 1940, was redesignated M.S.410 No. 1028, and a similarly modified machine was M.S.410 No. 1040. It was intended to fit the modified wing to all damaged M.S.406 fighters at a centre established by the Ateliers Industrièls de l'Air, and a further seventy-four M.S.406s were converted to M.S.410s after the collapse, some of these being supplied to the Croatian Air Force.

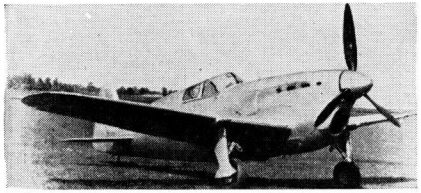
Type: *Single-seat Fighter.* **Power Plant:** *One* 860 *h.p. Hispano-Suiza* 12*Y*-31 *twelve-cylinder liquid-cooled engine.* **Armament:** *One Hispano-Suiza HS*-9 *or HS*-404 20-*mm. cannon with* 60 *rounds and two* 7.5-*mm. MAC* 1934 *machine guns with* 300 *r.p.g.* **Performance:** *Maximum speed,* 302 *m.p.h. at* 16,400 *ft.,* 248 *m.p.h. at sea level; cruising speed,* 248 *m.p.h. at* 16,400 *ft.; endurance,* 1 *hr.* 50 *min.; range,* 497 *mls.,* (*with two* 32 *Imp. gal. external tanks*), 932 *mls.; initial climb rate,* 3,543 *ft./min.; climb to* 16,400 *ft.,* 6 *min.; service ceiling,* 30,840 *ft.* **Weights:** *Empty,* 4,189 *lb.; normal loaded,* 5,364 *lb.; maximum,* 6,000 *lb.* **Dimensions:** *Span,* 34 *ft.* 9¾ *in.; length,* 26 *ft.* 9¼ *in.; height,* 9 *ft.* 3¾ *in.; wing area,* 172.223 *sq. ft.*

M-105*P-powered M.S.*406 *fighters, or "Super-Moranes", of the Finnish A.F.*

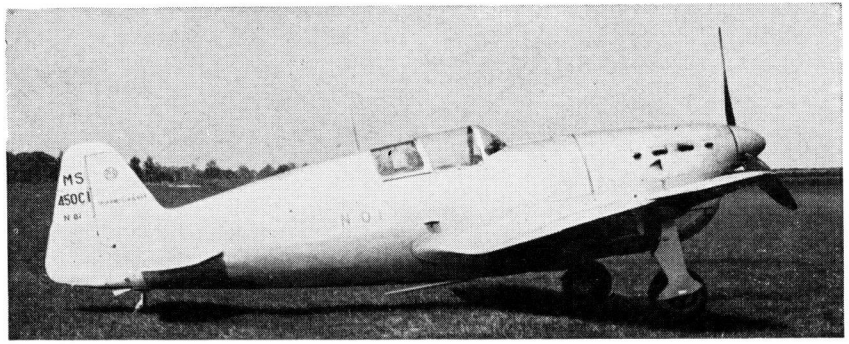
MORANE-SAULNIER M.S. 450

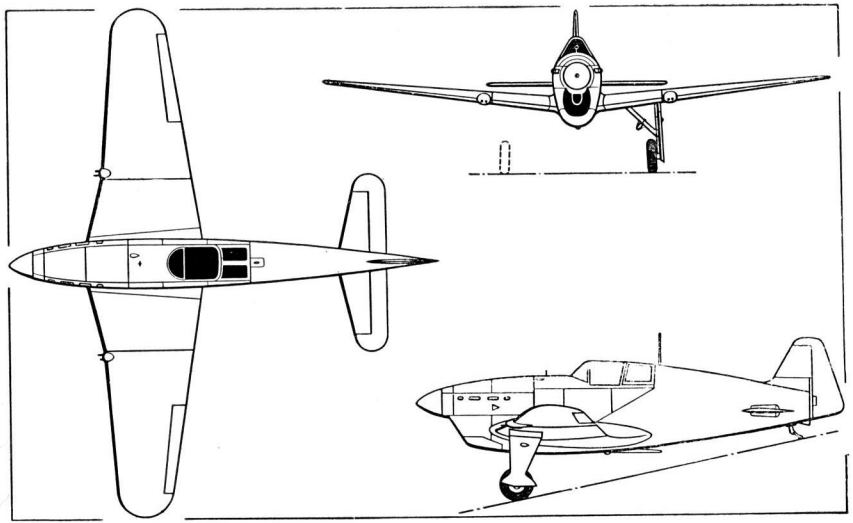
FRANCE

In 1937 a specification for a single-seat fighter to replace the M.S.406 was issued to the French aircraft industry. To fulfil the requirements of this specification four prototypes were produced; the Dewoitine D.520, the Arsenal VG-33, the C.A.O.200 and the M.S.450. The design of the last-mentioned type followed closely that of the M.S.406 which it was intended to replace, the characteristics of the earlier fighter being well-known. Extensive use was made of Plymax, a composite material consisting of plywood bonded to aluminium, for the wing structure, and the fuselage was a duralumin monocoque.



Three prototypes of the M.S.450 were built by Morane-Saulnier's Puteaux factory, the first of these making its initial flight on April 14, 1939 at Villacoublay. Initial flight tests confirmed the estimated performance, and the M.S.450-01 (illustrated by the accompanying photographs) was accepted by the CEMA (Centre d'Essais du Matériel Aérien) on June 6, 1939. The M.S.450-02 was completed in November 1939, and it was proposed to increase the wing-mounted armament from two to four 7.5-mm. machine guns with 500 r.p.g. in the production model. These were to be housed entirely in the wing profile whereas the twin wing-mounted guns of the prototypes were installed in swollen fairings. In the meantime, however, the Dewoitine D.520 had been placed in quantity production and, therefore,





no production orders were placed for the Morane-Saulnier fighter.

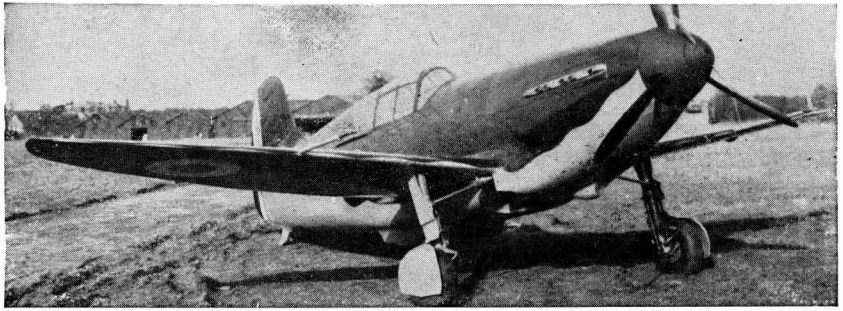
Development of the basic design was continued during the war years by the Morane-Saulnier design bureau, culminating in the M.S.540 which was manufactured under licence in Switzerland as the D-3802 with a Saurer/SLM-built Hispano-Suiza 12Y-S2 engine, the licence-built M.S.406 having been designated D-3801. The second Swiss-built prototype, the D-3802A, was modified up to production standards, and a progressive development, was the D-3803, which differed in having the more powerful Hispano-Suiza 12Y-S3 and an all-round-vision cockpit canopy.

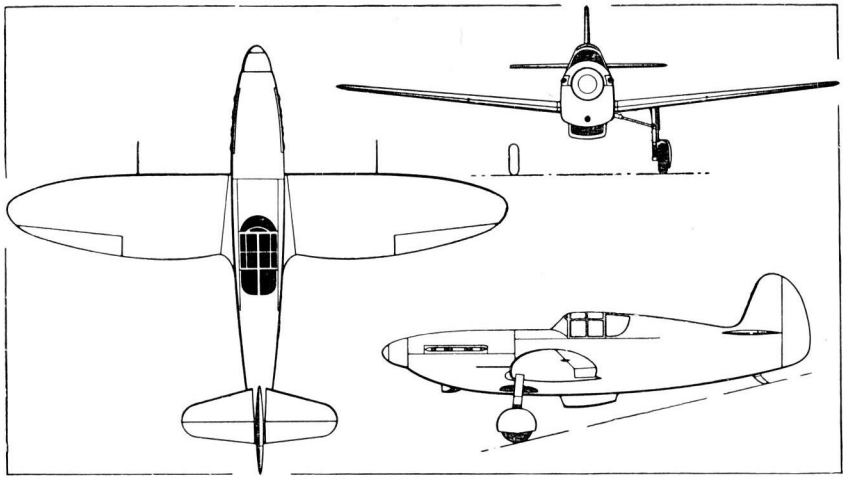
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,100 *h.p. Hispano-Suiza* 12 *Y-51 twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One* 20-*mm. Hispano-Suiza* 404 *cannon and two* 7.5-*mm. MAC* 1934 *machine guns.* **Performance:** *Maximum speed,* 348 *m.p.h. at* 16,400 *ft.; range,* 466 *mls. at* 13,120 *ft.; time to* 16,400 *ft.,* 6 *min.* 47 *sec.; service ceiling,* 32,800 *ft.* **Weights:** *Loaded (production model),* 5,813 *lb.* **Dimensions:** *Span,* 34 *ft.* 10 *in.; length,* 28 *ft.* 11¼ *in.; height,* 9 *ft.* 0 *in.; wing area,* 172.223 *sq. ft.*

Prior to the nationalisation of Les Mureaux in 1937 as a part of the S.N.C.A. du Nord, this company had produced a series of single-seat fighters which included the Mureaux 170, 180 and 190. The Mureaux 190 was a light-weight all-metal interceptor with a fixed undercarriage and powered by a 450 h.p. Salmson 12Vars twelve-cylinder inverted-Vee air-cooled engine, and the prototype was flown for the first time in 1936. With the absorption of Les Mureaux by the S.N.C.A. du Nord, Messrs. Brunet (the former Mureaux chief designer), Lemaitre and Hubert, continued the development of the Mureaux line of lightweight fighters at the former Potez-C.A.M.S. factory at Sartrouville, and in the autumn of 1938 began work on the Potez 230 which was a logical development of the Mureaux 190 featuring numerous refinements and a more powerful engine.

The Potez 230 employed a similar wing planform to that of the earlier fighter, the wing comprising two semi-elliptic sections which were attached at four points on the fuselage centre line. The leading and trailing edges of the wing were attached to a torsion box of integral construction—the first of its type to be flown—and hydraulically-operated split flaps were attached to the trailing edges. The oval section fuselage was built up of four longerons and a number of open-section frames, the forward section being covered by removable metal panels and the rear section having stressed skinning. Power was provided by an Hispano-Suiza 12Xcrs twelve-cylinder liquid-cooled engine rated at 670 h.p. at 13,120 ft. driving a Ratier airscrew, and the legs of the main Messier undercarriage members contracted as they retracted so that the main-wheels lay flat in fuselage wells.

Flight tests with the Potez 230 commenced at Villacoublay on March 30, 1940, the first flight lasting 20 minutes, with test pilot Georges Détré at the controls. Only minor teething troubles were encountered during the initial test phase, and on May 8, 1940, after





modifications to the coolant water pump and some softening of the undercarriage shock absorbers which had previously interrupted the fuel supply to the carburettors when the aircraft was taxi-ing over rough ground, the prototype attained speeds of 273 m.p.h. at sea level and 348 m.p.h. at 16,400 ft. The proposed installation of the more powerful Hispano-Suiza 12Y engine would, it was estimated, have resulted in a maximum speed of 391 m.p.h.

When German forces occupied Villacoublay in June 1940, they discovered the Potez 230 intact, and a Reichsluftfahrtministerium technical team, interested in the integral structure of the wing torsion box, had the prototype ferried to a German test centre, and seized all drawings and data related to the machine's construction. Performance data quoted in the following specification is that attained during test flying.

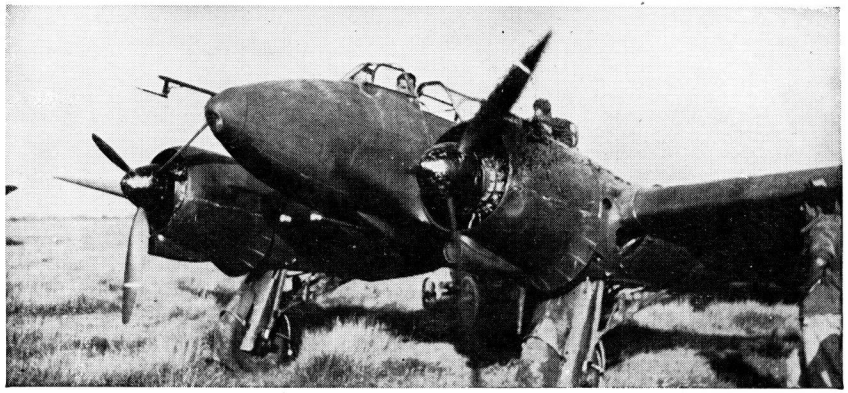
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 670 *h.p. Hispano-Suiza* 12*Xcrs twelve-cylinder Vee liquid-cooled engine.* **Armament:** (*Proposed*) *One* 20-*mm. engine-mounted Hispano-Suiza cannon and four wing-mounted* 7.5-*mm. MAC* 1934 *M* 39 *machine guns.* **Performance:** *Maximum speed,* 273 *m.p.h. at sea level,* 348 *m.p.h. at* 16,400 *ft.*; *endurance* (95 *per cent power*), 1 *hr.* 30 *min.* **Weights:** *Loaded,* 3,968 *lb.* **Dimensions:** *Span,* 28 *ft.* 6⅞ *in.*; *length,* 24 *ft.* 5½ *in.*; *height,* 7 *ft.* 2 *in.*; *wing area,* 118.403 *sq. ft.*

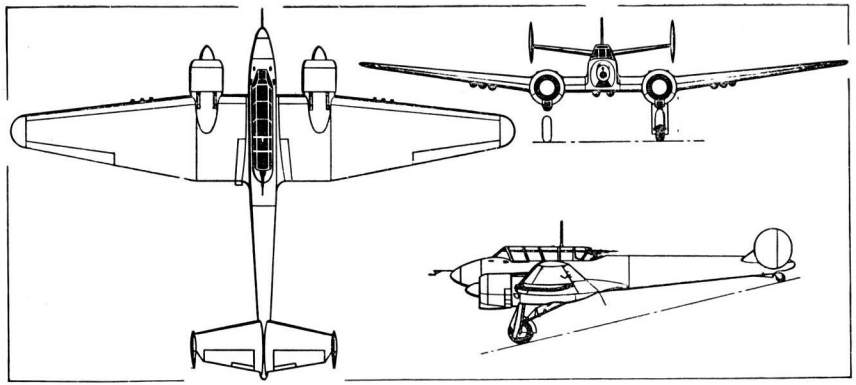
The Potez 631 was the Gnôme-Rhône 14M-powered development of the Potez 630 three-seat fighter which, like the Hanriot 220, Loire-Nieuport 20, Romano 110 and Bréguet 690, was built to meet the requirements of a specification issued in October 1934. The specification called for a three-seat aircraft with a fixed forward-firing armament of two 20-mm. cannon suitable for the escort, bomber interception and fighter director roles, and work on the Potez 630-01 began at Méaulte in April 1935, the aircraft flying for the first time a year later, in April 1936.

The Potez 630-01 proved to possess excellent flying qualities and, on May 6, 1936, despite the loss of a complete engine, the prototype was successfully landed by the Potez test pilot Nicolle. The prototype, which was transferred to Villacoublay on August 3, 1936, was powered by two 580 h.p. Hispano-Suiza 14Hbs engines and employed a braced wooden tail assembly suitable for the testing of fins and rudders of varied shapes. On August 31, 1936, the Potez 630-01 received its definitive, unbraced metal tail assembly and a new undercarriage with long-stroke shock absorbers, resuming test flights on November 20, 1936, and being accepted by the CEMA for official trials at the end of December. After the rectification of minor defects in longitudinal stability at low speeds and some improvement of the control balance, armament trials took place at Cazaux in June 1937.

The production of eighty Potez 630s was initiated in May 1937, these having Hispano-Suiza 14AB 10/11 engines, and simultaneously

All-black two-seat Potez 631 night fighters equipped several Groupes.

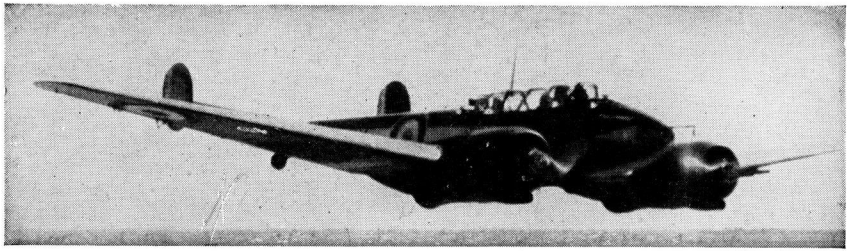




140 Potez 631s were ordered, these having Gnôme-Rhône 14M engines. In the meantime, the Potez 630-01 had been re-engined with Hispano-Suiza 14AB 02/03 engines, these, in turn, being replaced by 14AB 10/11 engines. With these the prototype attained a speed of 283 m.p.h. at 20,000 ft., climbed to 13,120 ft. in 5 min. 56 sec., and reached a service ceiling of 32,800 ft. The second airframe, fitted with 580 h.p. Gnôme-Rhône 14 Mars engines, was designated Potez 631-01 and flew for the first time during the second week of March 1937 at Méaulte. This prototype began official trials at the CEMA in November 1937.

The first production Potez 630 fighter was flown in February 1938, the first deliveries being effected before the end of the year to the Groupes de Chasse de Nuit III/1 and II/4 at Etampes and Reims. Both of these units re-equipped with the Potez 631 before amalgamation on May 1, 1939, to form the 13e Escadre de Chasse de Nuit. In the meantime considerable foreign interest was being displayed in the Potez 630 series. The Swiss government purchased two Potez 630s in February 1938, and the Czechoslovak Avia concern acquired a manufacturing licence for a variant designated Potez 636. Fifty additional Potez 631s were ordered by the French government in 1938 and, of these, twenty were diverted to Finland although they never reached the Finnish Air Force. An experimental dive-bomber variant for the French Navy was designated Potez 632, and in May 1938 the French government placed an order for 125 examples of a light bomber version, the Potez 633. In the event, twenty-four of the Potez 633s were delivered to Greece, twenty-nine were delivered to Rumania, and eight were despatched to China, although these were not, in fact, delivered to the Chinese government. The remaining Potez 633s were employed for training and test purposes.

Prior to September 1939, each single-seat



Groupe de Chasse received from two to five Potez 630s or 631s for use as "avions de commandment", and at the beginning of the war, two Potez 630s and ten Potez 631s were gathered from the single-seat units to form the Escadrille de Guet (Warning) I/16. These aircraft were flown as three-seaters, but those of GC II/8 based in southern France and of GCN I/13 and II/13 employed as night fighters in the Paris area were flown as two-seaters. On October 16, 1939, the Escadrille de Chasse de Nuit 2/562 was formed with Potez 631s to provide night fighter cover for the Lyons-Saint Etienne area, and on January 1, 1940, the escadrilles of GCN I/13 and II/13 were separated to form autonomous escadrilles—1, 2, 3 and 4/13—while ECN 2/562 became Escadrille 5/13. On January 29th, the Escadrille de Guet I/16 was redesignated Escadrille de Chasse Multiplace de Jour I/16.

A Potez 631 was test flown with a supplementary forward-firing armament of six 7.5-mm. MAC machine guns mounted under the wings, and on February 8, 1940, it was decided to modify all Potez 631s in a similar fashion. In February 1940, GC II/8 handed over its Potez 631s to the shore-based naval Escadrilles AC 1 and AC 2, and at the time of the German onslaught in May, seven Potez 631-equipped escadrilles were based in northern France with an eighth based at Loyettes, near Lyons. Subsequently, the performance of the Potez 631 as an interceptor was found wanting, and many were used for ground strafing operations. After the armistice, all but two of the Potez 631-equipped escadrilles (1/13 and 4/13) were disbanded. One escadrille was later transferred to Tunisia, and the Potez 631s of the second escadrille were seized by the Luftwaffe during the German occupation of Vichy France.

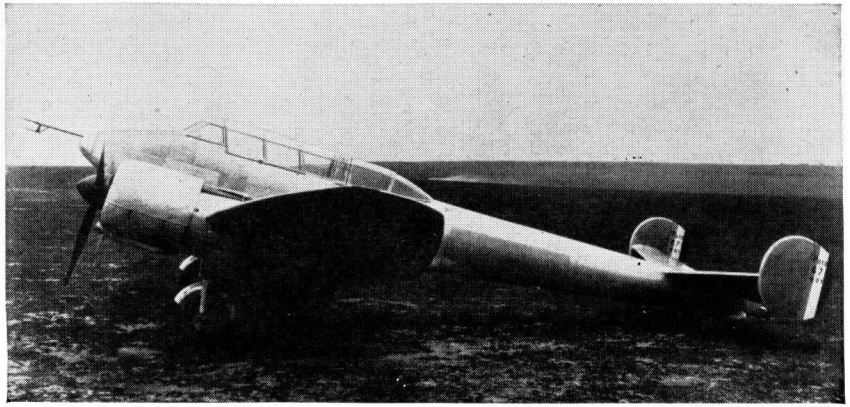
Type: *Two/three-seat Long-range and Night Fighter.* **Power Plants:** *Two* 660 *h.p. Gnôme-Rhône* 14M6/7 *fourteen-cylinder air-cooled radial engines.* **Armament:** *Two forward-firing* 20-*mm. Hispano-Suiza HS*-9 *cannon and six* 7.5-*mm. MAC* 1934 *machine guns, and two flexibly mounted* 7.5-*mm. MAC* 1934 *machine guns.* **Performance:** *Maximum speed,* 276.5 *m.p.h. at* 13,120 *ft.; climb to* 13,120 *ft.,* 9 *min.; service ceiling,* 29,530 *ft.; cruising speed,* 248.5 *m.p.h. at* 13,120 *ft.; endurance,* 2 *hr.* 30 *min.* **Weights:** *Empty,* 6,526 *lb.; loaded,* 9,921 *lb.* **Dimensions:** *Span,* 52 *ft.* 6 *in.; length,* 36 *ft.* 3¾ *in.; height,* 11 *ft.* 9¾ *in.; wing area,* 351.979 *sq. ft.*

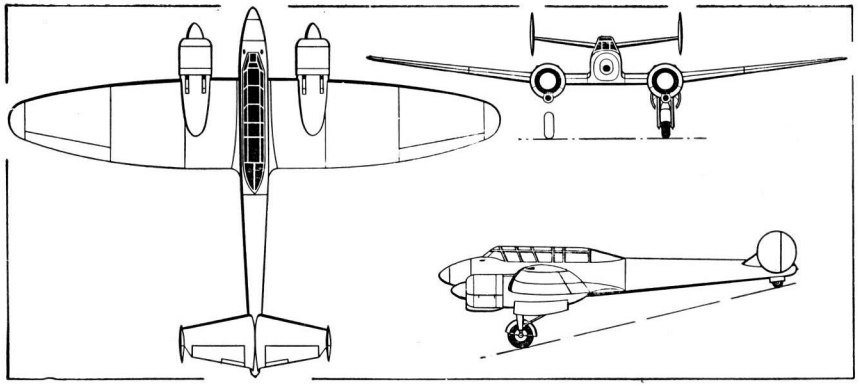
POTEZ 671 FRANCE

The Potez 671 two-seat long-range escort fighter and bomber destroyer was a development of the Potez 670 which had been designed to meet the requirements of a 1936 specification calling for a three-seat fighter with an endurance of three hours at ninety per cent maximum speed. After the visit to the Luftwaffe of General Vuillemin, Chief of Staff of the Armée de l'Air, in August 1938, the specification was revised, one crew member being omitted from the aircraft, and in this form the Potez 670-01 flew for the first time on March 30, 1939, competing with the Hanriot NC-600, the Caudron C.900 and the LeO.50 (later redesignated S.E.100).

The fuselage of the Potez 670 was essentially similar to that of the earlier Potez 631, with a long glazed canopy enclosing the pilot, who was seated in front of the wing leading edge, and the navigator/gunner. The proposed armament comprised two forward-firing 20-mm. Hispano-Suiza HS-404 cannon and two forward-firing 7.5-mm. MAC machine guns, and provision was made for either one 20-mm. HS-404 cannon or two 7.5-mm. machine guns firing aft and carried on a flexible mounting in the rear cockpit. The two-spar wing was of elliptical planform and possessed a slimmer profile than that of the Potez 631, and power was provided by two 700 h.p. Gnôme-Rhône 14 Mars fourteen-cylinder air-cooled radials in long-chord cowlings, the fuel tanks for which

The Potez 671 *was entering production at Méaulte in May–June,* 1940.





were housed in the wings and provided a total capacity of 220 Imp. gal. Unlike the main undercarriage members of the Potez 631, the wheels of which protruded from their wells when retracted, the undercarriage of the Potez 670 was totally enclosed when retracted, including the tail-wheel.

After the completion of initial trials, the Potez 670-01 was re-engined with Hispano-Suiza 14AB 12/13 radials each rated at 800 h.p. for take-off and 745 h.p at 2,400 r.p.m. at 2,130 ft. With these engines the prototype resumed test flights in July 1939 as the Potez 671-01. Several versions of the fighter with more powerful engines were proposed by the Société Nationale de Constructions Aéronautiques du Nord (which had absorbed the Potez concern under the Nationalisation Law) but few flight trials had been conducted with the Potez 671-01 at the time of the French collapse, and the sole prototype was destroyed during the German onslaught. The factory at Meaulte had initiated work on a first production batch of forty Potez 671 fighters.

Type: *Two-seat Long-range Escort Fighter and Bomber Interceptor.* **Power Plants:** *Two* 800 *h.p. Hispano-Suiza* 14*AB* 12/13 *fourteen-cylinder air-cooled radial engines.* **Armament:** *Two forward-firing* 20-*mm. Hispano-Suiza HS-*404 *cannon, two forward-firing* 7.5-*mm. MAC* 1934 *machine guns and one aft-firing* 20-*mm. HS-*404 *cannon or two* 7.5-*mm. MAC machine guns.* **Performance:** *Maximum speed,* 275 *m.p.h. at* 9,840 *ft.,* 301 *m.p.h. at* 16,400 *ft.,* 311 *m.p.h. at* 19,685 *ft.; climb to* 3,280 *ft.,* 1 *min.* 35 *sec., to* 9,840 *ft.,* 4 *min.* 50 *sec., to* 20,000 *ft.,* 10 *min.; service ceiling,* 33,460 *ft.; range,* 1,243 *mls.* **Weights:** *Empty,* 7,023 *lb.; loaded,* 10,419 *lb.* **Dimensions:** *Span,* 49 *ft.* 6½ *in.; length,* 35 *ft.* 5⅛ *in.; height,* 10 *ft.* 8¾ *in.; wing area,* 349.828 *sq. ft.*

ROUSSEL 30

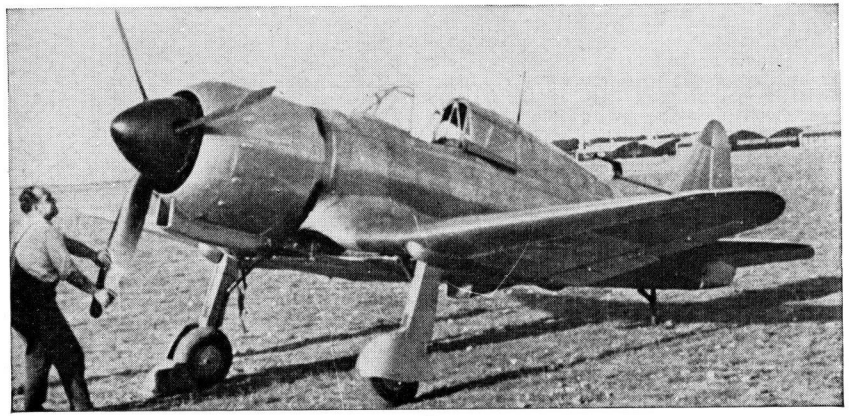
FRANCE

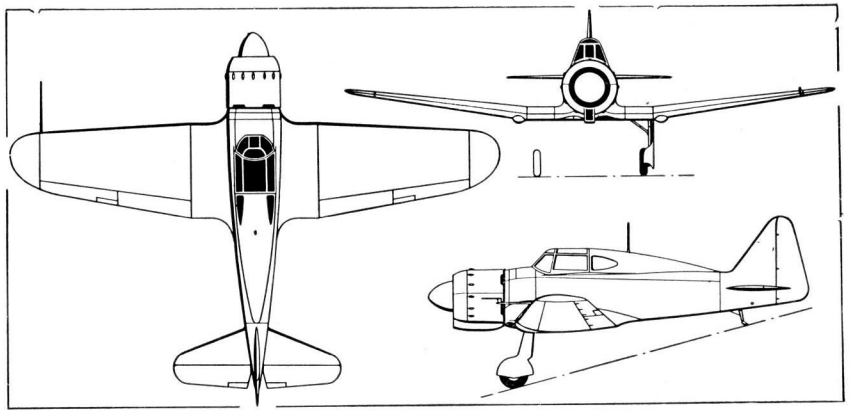
The diminutive Roussel 30 fighter-bomber was designed and built privately by M. Roussel, the brother of the designer of the Bloch M.B.150 fighter. Construction of the prototype began in the autumn of 1938 at Courbevoie, near Paris, and the machine was completed within six months, flying for the first time in April 1939 at the Etampes Armée de l'Air base.

The Roussel 30's structure comprised a duralumin monocoque fuselage and an all-metal wing with fabric-covered ailerons and flaps on the outboard panels and a metal-skinned split-flap across the centre section. Tanks between the main and auxiliary wing spars housed 88 Imp. gal. of fuel, a Messier retractable undercarriage was fitted, and power was provided by a Gnôme-Rhône 14M7 radial engine.

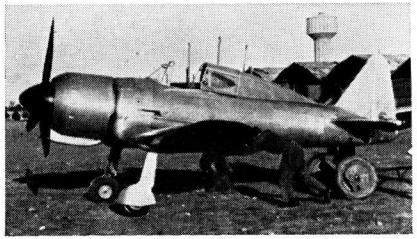
Initial flight trials dictated some modification to the rudder balance and the fitting of an improved locking system for the tailwheel, and after completing thirty hours in the air, the Roussel 30 was handed over to the CEMA (Centre d'Essais du Matériel Aérien) for official trials in August 1939. During these trials a 22 Imp. gal. fuel tank was installed behind the cockpit and, in May 1940, the armament was installed. No 20-mm. Hispano-Suiza 404 cannon were available, as these were required for operational aircraft, and, therefore, two 20-mm. Oerlikon AS cannon were fitted, installed immediately outboard of the undercarriage attachment points. Attachment points were provided under the centre fuselage for one 550-lb. bomb.

The proposed radio equipment was not





installed and, owing to the design of the internal contours of the intake, the Gnôme-Rhône engine gave optimum power 2,950 ft. higher than the specified altitude. Handling trials were extremely successful and the Roussel 30 prototype was being fitted with a new 800 h.p. version of the Gnôme-Rhône 14M engine when the German forces approached Paris. The fighter was, therefore, hastily dismantled and sent to Bordeaux where it was later destroyed when the building in which it was stored burned down.

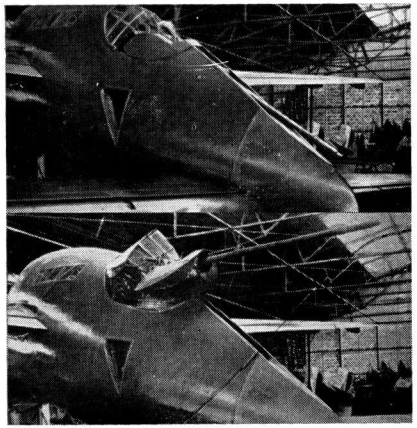


Type: *Single-seat Fighter-bomber.* **Power Plant:** *One* 690 *h.p. Gnôme-Rhône* 14*M*7 *fourteen-cylinder air-cooled radial engine.* **Armament:** *Two* 20-*mm. Oerlikon AS cannon and provision for one* 550-*lb. bomb.* **Performance:** *Max. speed,* 323 *m.p.h. at* 19,030 *ft.; cruising speed* (50% *power*) 261 *m.p.h.; initial climb rate,* 3,740 *ft./min.; endurance, full combat power,* 1 *hr.,* 50% *power,* 2 *hrs.* **Weights:** *Empty,* 2,271 *lb.; loaded,* 3,891 *lb.* **Dimensions:** *Span,* 25 *ft.* 5 *in.; approximate length,* 20 *ft.; approximate height,* 6 *ft.* 6 *in.; wing area,* 107,639 *sq. ft.*

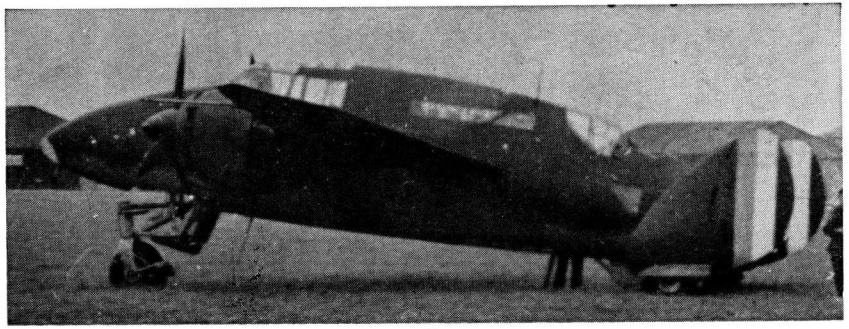
SUD-EST S.E. 100

FRANCE

With the issue of an official specification for a twin-engined fighter to replace the Potez 631, Messrs. Mercier and Lecarme of the Société Nationale de Constructions Aéronautiques de Sud-Est (SNCASE) projected an unconventional three-seat aircraft carrying an armament of three 20-mm. cannon, powered by two 800 h.p. Gnôme-Rhône 14 Super-Mars radials and designated LeO 50 (the Lioré-et-Olivier works being a part of the SNCASE). It was soon obvious that the LeO 50 would be underpowered and would not meet the specification's performance requirements. The basic design was, therefore, scaled-up, 1,030 h.p. Gnôme-Rhône 14N radials were incorporated and, redesignated S.E. 100, prototype construction commenced in April 1938 at La Courneuve, near Paris.



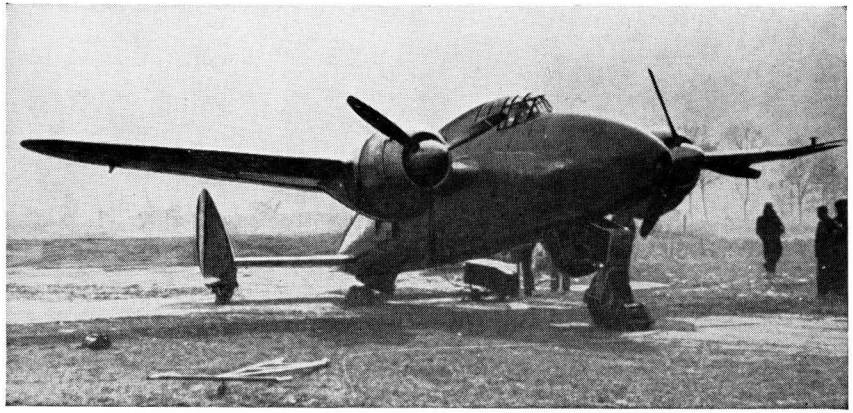
(*Right*) *The S.E.* 100-01 *had a single* 20-*mm. cannon which retracted into a slot in the rear fuselage.*

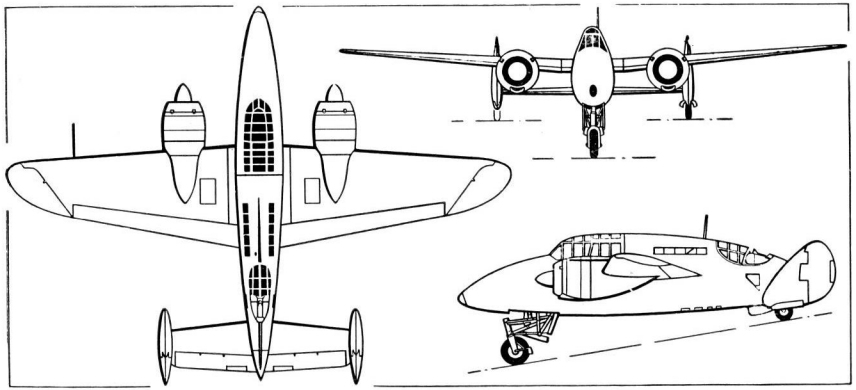


The wing was of wooden construction and comprised a one-piece torsion box of spruce to which the leading and trailing edges were attached with steel strips. The torsion box housed fuel tanks between the fuselage and engine nacelles, and in order to provide the maximum flap area, the ailerons articulated obliquely at the extreme tips of the wings. The Mercier engine cowlings were similar to those of the LeO 451 bomber, and the fuselage was a welded steel-tube structure with duralumin skinning. The undercarriage was unusual in that it comprised a single large nosewheel with small outrigger wheels retracting into the vertical tail surfaces. The nosewheel was steerable and was claimed to be the first of its type to be tested. The outrigger or auxiliary wheels were taken from a D.500 fighter.

The S.E.100-01 was flown for the first time from Villacoublay on March 29, 1939. During the ensuing tests a small retractable ventral fin was added and, in February 1940, the aircraft was ferried from Villacoublay to Marignane in 1 hr. 17 min. At Marignane, as a result of various refinements, including improved wing root fairings and new airscrew spinners, the maximum speed was increased from 348 m.p.h. to 360 m.p.h., and the prototype performed extremely well until, in April 1940, the S.E.100-01 crashed when the pitch of one airscrew was reversed inadvertently at low altitude.

In the meantime, a second prototype had been built at La Courneuve, this differing from its predecessor in some respects. The forward-firing armament was increased from four to six 20-mm. cannon, and rear-firing armament was boosted from one 20-mm. cannon on a SAMM electro-pneumatic mount in the observer's cockpit to two 20-mm. cannon in a dorsal





turret and one 20-mm. cannon on a ventral mount. The communications tunnel between the cockpits was removed in order to increase fuselage fuel capacity, and the lower fuselage tank was made removeable so that bomb racks could be installed in its place. The German occupation of Paris prevented the S.E.100-02 being transported to Villacoublay.

In June 1940 the Paris Citroën car plant was tooling for the mass production of S.E.100 components, delivery of which was scheduled to commence at the end of that year. The production variant was to have embodied a redesigned all-metal one-piece wing with a structure similar to that of the outer panels of the LeO 451 bomber's wing. The undercarriage was to have comprised two forward wheels with a single disc brake, a third wheel retracting into the rear fuselage, and fin-mounted outrigger wheels for stability during taxi-ing. Armament was to have been similar to that of the S.E.100-02, apart from the addition of a second ventral 20-mm. cannon, bringing total cannon armament to ten 20-mm. guns. Loaded weight was estimated at 16,535 lb. Proposed production variants included the S.E.101 with Pratt and Whitney Twin Wasp engines, and a version with Rolls-Royce Merlins.

Type: *Two-seat Long-range Escort and Attack Fighter.* **Power Plants:** *Two* 1,080 *h.p. Gnôme-Rhône* 14*N*-20/21 *fourteen-cylinder air-cooled radial engines.* **Armament** (*S.E.*100-01): *Four forward-firing* 20-*mm. Hispano-Suiza* 404 *cannon and one rear-firing* 20-*mm. H.S.*404 *cannon on a flexible mount.* **Performance:** *Maximum speed,* 360 *m.p.h. at* 21,325 *ft.*; *economical cruising speed,* 310 *m.p.h. at* 16,400 *ft.* **Weights:** *Normal loaded,* 14,330 *lb.* **Dimensions:** *Span,* 51 *ft.* 6 *in.*; *length,* 38 *ft.* 6½ *in.*; *height,* 14 *ft.* 0½ *in.*; *wing area,* 355.854 *sq. ft.*

ARADO AR 240-440 GERMANY

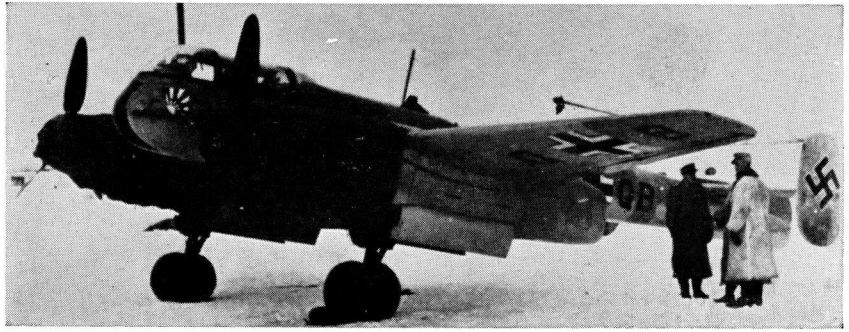
Early in 1938 the Reichsluftfahrtministerium, or R.L.M., proposed to Dipl. Ing. Walter Blume, technical director of the Arado Flugzeugbau, that his company undertake a design study for a fast, heavily-armed, two-seat aircraft in the Zerstörer category, suitable for the roles of heavy fighter, dive-bomber and reconnaissance. With R.L.M. acceptance of the project, the aircraft received the designation Ar 240, and construction commenced with Dipl. Ing. van Nes as chief project engineer, Oberingenieur Hans Rebeski as construction supervisor, and Dipl. Ing. Kosin as aerodynamicist. The design embodied a number of advanced features, not least of which were its remotely-controlled defensive barbettes.

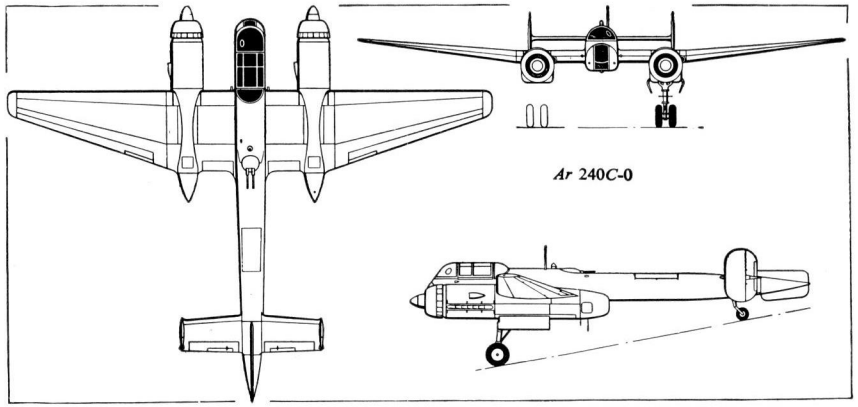
The first prototype, the Ar 240V1, was completed as a fighter/dive-bomber powered by two 1,175 h.p. DB 601A engines, and flew in June 1940. Automatic slots were fitted to the wing leading edges, and a four-ribbed "umbrella" type dive brake was attached to the extreme rear fuselage. It was joined by the Ar 240V2 in August 1940, this differing from its predecessor solely in having a forward-firing armament of two 7.9-mm. MG 17 guns in the wing roots and two 20-mm. MG 151 cannon in the fuselage, neither machine having the remotely-controlled barbettes which were under test on a Bf 110C.

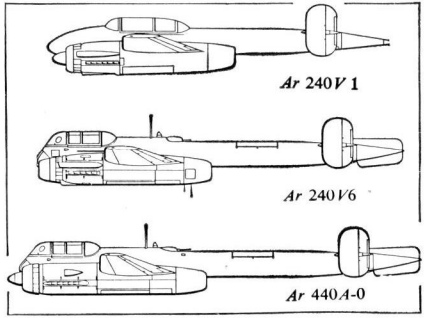
The Ar 240 proved to possess appallingly bad handling characteristics and to be completely unstable, and extensive redesign of the fuselage was obviously necessary. This redesign was incorporated in the Ar 240V3, in which the cockpit was pressurised and moved forward to the extreme nose, the overall length being increased from 38 ft. 8½ in. to 40 ft. 7⅓ in., and the tail brake replaced by a fixed cone carrying auxiliary fins. This aircraft was the first to be fitted with the remotely-controlled dorsal and ventral barbettes, each of which mounted twin 7.9-mm. MG 81 machine guns, forward firing armament being similar to that of the V2. Flight testing revealed the fact that the aircraft was still unstable, and new ailerons were designed and fitted, after which the aircraft was evaluated in service in the reconnaissance role during 1941–42 by a Luftwaffe unit based on the Channel coast.

The Ar 240V4 was a dive-bomber prototype in which the DB 601As were supplanted by 1,750 h.p. DB 603As and provision made for the carriage of four 550-lb. or 1,100-lb. bombs. The tail-mounted dive brake employed by the first and second prototypes was again fitted, increasing overall length to 42 ft. 9¾ in., but by this time the Luftwaffe was losing interest in the dive-bomber, and Arado were instructed

The Arado Ar 240A-02 (V6) seen here in service on the Russian front with the Eismeer-Geschwader.







to concentrate on the reconnaissance, heavy fighter and fighter-bomber tasks. Thus, the next machines completed, the pre-production Ar 240A-01 and A-02 (which also bore the Versuchs numbers V5 and V6 respectively), both of which flew in October 1942, were delivered as reconnaissance aircraft.

These were fitted with a redesigned wing which retained the original 46 ft. 11 in. span, power was provided by two 1,350 h.p. DB 601E engines, and forward-firing armament was reduced to two MG 17s. Three additional pre-production A-series machines were built by Arado, and the Ago concern at Oschersleben had completed tooling for the quantity production of the aircraft when, in December 1942, the production line was stopped by the R.L.M. The Ar 240A-03 was initially flown with DB 601Es but these were later supplanted by 1,810 h.p. BMW 801TJ air-cooled radials, and the Ar 240A-04 (A-0/U1) and A-05 (A-0/U2) were powered by DB 603A engines and carried no defensive armament.

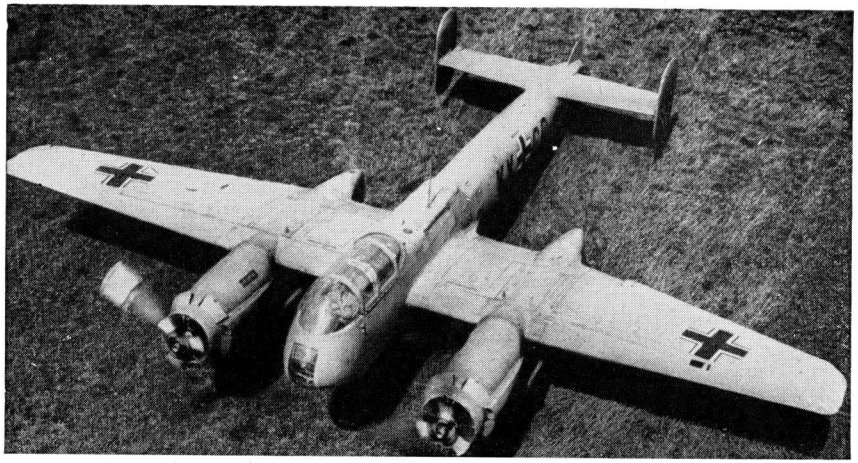
All five Ar 240A-0s entered service with the Luftwaffe. The A-01 and A-02 served on the Russian Front with the Eismeer-Geschwader, and in July 1943 the A-03 was delivered to 2(F)/122 at Frosinone. This aircraft was written off in a bad landing after returning safely from its first operational reconnaissance flight, and in September 1943, by which time 2(F)/122 had been transferred to Perugia, the A-04 arrived. This enjoyed no better luck than its predecessor as serious engine trouble developed during its first operational sortie and, after temporary repairs, it had to be ferried back to Germany.

The Ar 240V7 and V8 were also designated Ar 240B-01 and B-02, these being flown respectively in October and December 1942, and were essentially similar to the Ar 240A-0 apart from the installation of 1,475 h.p. DB 605A engines. Both Ar 240B-0s entered service with the Luftwaffe, but the aircraft's handling characteristics still left much to be desired, and therefore the wing profile was improved and the span increased, this wing appearing on the Ar 240C fighter and fighter-bomber.

The Ar 240C-01, which also bore the Versuchs number V9, was powered by two 1,750 h.p. DB 603A-2 engines and carried a forward-firing armament of four MG 151 cannon. The remotely-controlled barbettes each mounted twin MG 131s. The Ar 240C-02 (V10) was an experimental night fighter version with two additional forward-firing MG 151 cannon in a bulged WT 151A (Waffen-Tropfen 151A) ventral housing; the Ar 240C-03 (V11) had GM 1 power boost (nitrous oxide injected into the supercharger) which raised maximum level speed by 35 m.p.h., and the C-04 (V12) was similarly equipped.

The Ar 240C-0s flew early in 1943, and four production versions were proposed: the C-1 heavy fighter, the C-2 night fighter, the C-3 light bomber, and the C-4 high-altitude reconnaissance aircraft. These were all to have been powered by the 1,900 h.p. DB 603G, and similar variants of the Ar 240D were proposed, these being powered by the 2,000 h.p. DB 614. However, since the beginning of 1942 an improved aircraft, the Ar 440, had been under development in parallel with the Ar 240, and further work on the earlier type was abandoned.

The Ar 440 was essentially similar to the Ar 240C, although the fuselage had been lengthened by some three feet by the insertion of an additional section aft of the cockpit, and power was provided by two DB 603G engines with GM 1 boost. It was proposed that the production Ar 440 should be powered by 2,000 h.p. DB 627A/B engines. The prototypes bore both pre-production numbers and Versuchs numbers, and the Ar 440V1 (alias Ar 440A-01) was flown in the summer of 1942. The Ar 440V2, V3 and V4 (Ar 440A-02, 03 and 04)



The Ar 240V3 (above) embodied considerable re-design, the cockpit being moved forward.

were similar to the first prototype and all joined the flight test programme in the autumn of 1942. The V4 was evaluated by a Luftwaffe test pilot, Oberleutnant Thierfelder, on January 21, 1943, but despite an enthusiastic report on the qualities of the Ar 440, the R.L.M. decided against quantity production of the machine.

The specification relates to the Ar 240C-0, figures in parentheses relating to the Ar 440A-0.

Type: *Two-seat Heavy Fighter and Bomber Interceptor.* **Power Plants:** *Two* 1,750 (1,900) *h.p. Daimler-Benz DB* 603*A*-2 (*DB* 603*G*) *twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Four forward-firing* 20-*mm. MG* 151 *cannon* (*two* 30-*mm. MK* 108 *cannon and two* 20-*mm. MG* 151 *cannon*) *and four rear-firing* 13-*mm. MG* 131 *machine guns in two remotely-controlled MG* 131*Z barbettes.* **Performance:** *Maximum speed,* 419 *m.p.h. at* 19,680 *ft.* (435 *m.p.h. at* 27,200 *ft.*), 454 *m.p.h.* (467 *m.p.h.*) *at* 36,700 *ft. with GM*1 *power boost,* 358 *m.p.h. at sea level; normal range,* 1,162 *mls. at* 19,680 *ft.; max. range,* (1,680 *mls.*); *service ceiling,* 34,450 *ft.* **Weights:** *Empty,* 18,695 (20,282) *lb.; loaded,* 23,258 (26,896) *lb.* **Dimensions:** *Span,* 54 *ft.* 5½ *in.* (53 *ft.* 4½ *in.*); *length,* 43 *ft.* 9½ *in.* (46 *ft.* 10¼ *in.*): *height,* 12 *ft.* 11½ *in.* (13 *ft.* 1½ *in*); *wing area,* 367.737 *sq. ft.*

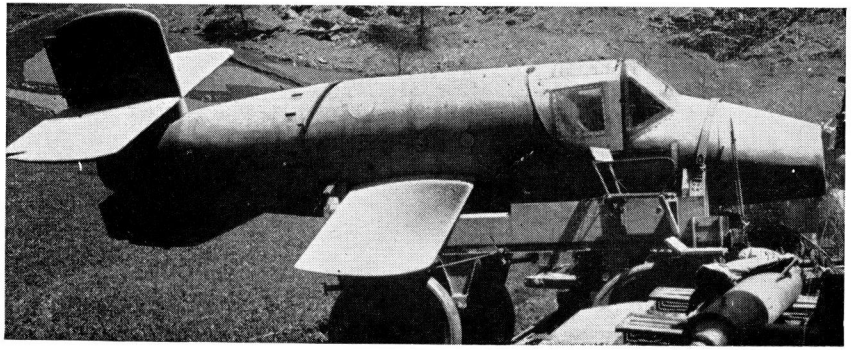
BACHEM BA 349A NATTER

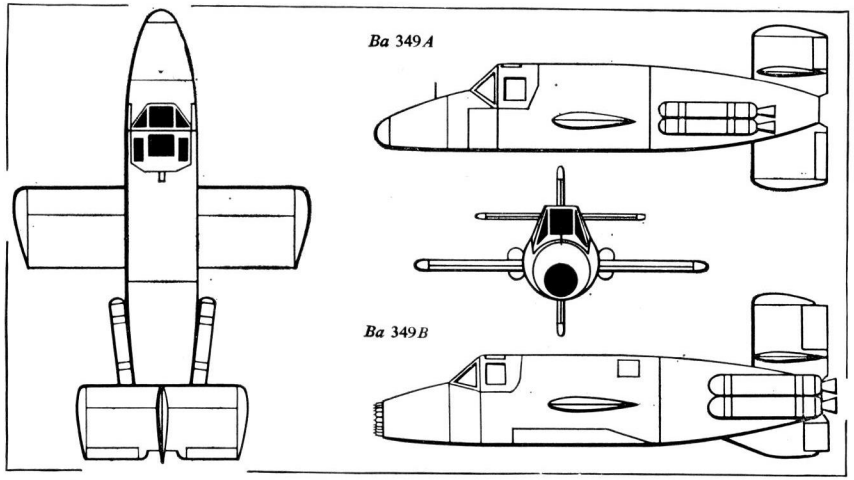
GERMANY

The Ba 349A Natter (Adder) was an inexpensive, semi-expendable, rocket-propelled interceptor conceived by the Bachem Werke G.m.b.H. in August 1944 under the project designation BP-20A. The keynote of the Natter was simplicity, workmanship and material quality being consciously sacrificed to achieve this end. Apart from the fuel tanks and wing mainspar, low-grade, non-essential materials were used throughout. The diminutive wings were simple wooden structures, as was also the cruciform tail, and the fuselage was a wooden monocoque. The nose housed a battery of rocket projectiles, the pilot was protected by armoured bulkheads and a bullet-proof windscreen, and immediately aft of the pilot were the T-stoff (hydrogen peroxide and water) and C-stoff (hydrazine hydrate and methyl alcohol) tanks for the rocket motor mounted in the rear fuselage. For launching, the Natter was attached to three near-vertical rails 31 ft. in length, four jettisonable solid-fuel booster rockets being attached to the fuselage to provide initial acceleration.

Within three months of the inauguration of the Natter project several machines were ready for testing. Ballasted to a weight of 3,748 lb., one Natter was towed to 18,000 ft. by an He 111 for gliding trials, its pilot, Zübert, declaring that stability was excellent and that the controls were light and effective at all speeds between 125 and 425 m.p.h. The first pilotless launching without the primary rocket motor installed was successfully accomplished on December 22, 1944, ten similar launchings being made before, on Febuary 23, 1945, the first pilotless launching with the primary rocket installed was effected. A few days later, Lieut. Lothar Siebert undertook the first piloted test in which he lost his life, but three manned tests

The Ba 349B (below) was an improved version of the Natter with a 4,400-lb. thrust HWK 109-509C.





were subsequently completed successfully, and, by April 1945, thirty-six Ba 349A Natters had been completed.

The operational plan was to launch the Natter as enemy bombers approached, controlling it entirely from the ground by radio/radar link until the interceptor was within a mile of the enemy formation. The pilot would then take over manual control, and jettison the nose cap to expose the missiles which would then be launched. The pilot would then eject himself from the cockpit and, simultaneously, the rear fuselage containing the rocket motor would break off and descend by parachute.

The first ten Natters were set up near Kircheim on Teck to await the arrival of enemy bombers, but the approach of American ground forces necessitated the destruction of the interceptors before they could be employed operationally. An improved version, the Ba 349B with a 4,400 lb. HWK 109-509C with auxiliary cruising chamber, was built as a prototype. This attained 620 m.p.h. and a climb rate of 37,400 ft./min.

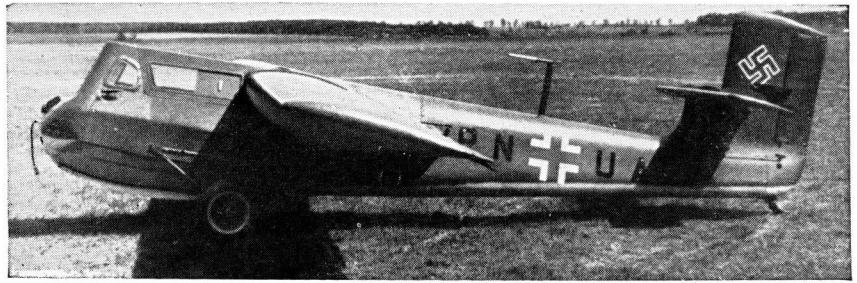
Type: *Single-seat Target-defence Interceptor.* **Power Plant:** *One* 3,750 *lb. Walter HWK* 109-509*A rocket and four jettisonable Schmidding rockets providing* 1,100 *lb. thrust each for one minute.* **Armament:** *Twenty-four* 55-*mm. R4M unguided rockets.* **Performance:** *Maximum speed,* 560 *m.p.h. at* 16,400 *ft.; initial climb rate,* 35,800 *ft./min.; powered endurance,* 2 *min.* **Weights:** *Loaded,* 4,800 *lb.* **Dimensions:** *Span,* 13 *ft.* 1¼ *in.; length,* 21 *ft.* 3 *in.; wing area,* 51.6 *sq. ft.*

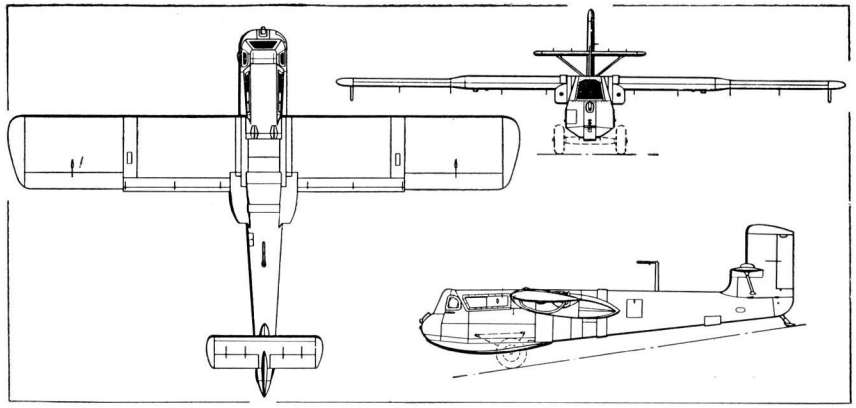
BLOHM UND VOSS BV 40

GERMANY

The Blohm und Voss Bv 40 "glide-fighter" was a radical idea for intercepting U.S.A.A.F. heavy bomber formations operating by daylight. Battle experience had indicated that the frontal area of an Fw 190's radial engine—some seventeen square feet—provided a target which could be hit by an average gunner at a range of more than a thousand yards. This frontal area could only be reduced drastically by eliminating the engine, and the "glide-fighter", a small heavily armed and armoured glider manufactured largely from non-strategic materials and towed to attack altitude by an orthodox fighter, provided such a small target in a head-on attack that it would be virtually invisible to the bomber's gunners before it had actually opened fire with its 30-mm. cannon.

Designed by Dr. Richard Vogt, the Bv 40 was selected by the R.L.M. in the autumn of 1943 from a number of designs. Its keynote was simplicity, and the Bv 40 could be built by carpenters, joiners, locksmiths and welders having no previous experience of aircraft construction. The pilot, who reclined on a padded bench, had considerable armour protection, the whole cockpit being constructed of welded sheet metal ranging from 20-mm. to 5-mm, in thickness. The centre fuselage was of metal, and the aft fuselage, wings and tail surfaces were of wood. A simple, twin-wheel bogie was employed for take-off, being jettisoned immediately the "glide-fighter" had left the ground, and the landing was effected on a semi-retractable skid. Armour protection accounted for some twenty-six per cent of the aircraft's weight, and it was proposed that the Bv 40 be towed to operational altitude by a Bf 109G fighter, released from the towplane at 800–2,400 feet above the bomber formation, and attack the selected bomber head-on in a 20° angle dive. The original scheme proposed that, after the initial cannon attack, the Bv 40 pilot would select a second bomber and attack this with a device known as "*Gerät Schlinge*"—a wire cable suspended from the glider and carrying a small explosive charge. However, this device was abandoned as its installation necessitated the deletion of one of the 30-mm. cannon.





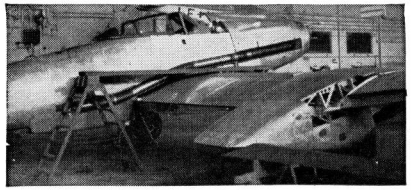
Nineteen prototypes (V1 to V19) and two hundred production Bv 40s were ordered, and the Bv 40V1 made its first flight at the end of May 1944 towed behind a Bf 110. After modifications, a second flight test was made on June 2, 1944 at Wenzendorf airfield, but the pilot lost control and the prototype crashed. The second prototype, the Bv 40V2, flew on June 5th, the third prototype was tested to destruction, and four additional prototypes had been flown when the programme was abandoned in the autumn of 1944.

Type: *Single-seat Glider Interceptor.* **Power Plant:** *None.* **Armament:** *Two* 30-*mm. MK* 108 *cannon with* 35 *r.p.g.* **Performance:** *Maximum speed attainable in dive,* 560 *m.p.h.; maximum speed of Bf* 109*G towing one Bv* 40, 344 *m.p.h. at* 19,000 *ft., towing two Bv* 40s, 315 *m.p.h. at* 19,000 *ft.; time to climb to* 23,000 *ft., one Bv* 40, 12 *min., two Bv* 40s, 16.8 *min.* **Weights:** *Empty,* 1,844 *lb.; loaded,* 2,094 *lb.* **Dimensions:** *Span,* 25 *ft.* 11 *in.; length,* 18 *ft.* 8½ *in.; height,* 5 *ft.* 4⅛ *in.; wing area,* 93.646 *sq. ft.*

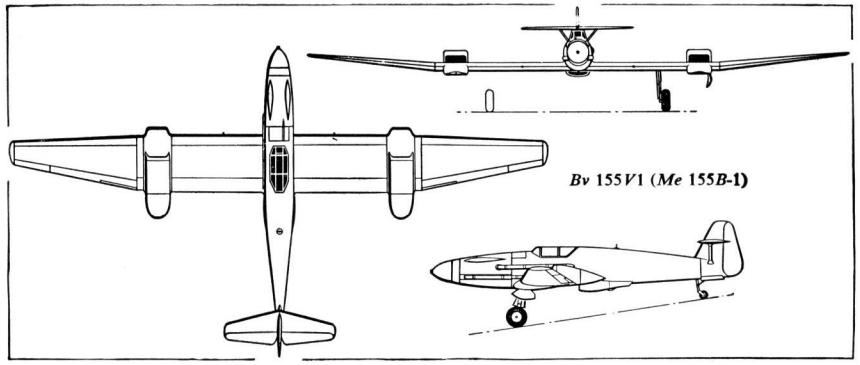
BLOHM UND VOSS BV 155 GERMANY

The most bizarre piston-engined fighter evolved by the German aircraft industry during the Second World War was without doubt the ungainly Blohm und Voss Bv 155 high-altitude interceptor with its inordinately large wing span and unique wing-mounted radiators. The development history of this warplane was as curious as its appearance, for its development was commenced early in 1942 by the Messerschmitt A.G. as the Me 155 shipboard fighter. This was to have employed the fuselage of the Bf 109G married to an entirely new wing, a wide-track undercarriage and a 1,475 h.p. DB 605A engine.

Interest in shipboard fighters in Germany waned during the autumn of 1942, but during the following November the design was ressurected to fulfil a requirement for a high-speed single-seat bomber capable of carrying a 2,200-lb. offensive load. Designated Me 155A, the design was stripped of most of its defensive armament and all carrier equipment, internal fuel capacity was increased and a long tailwheel leg fitted to provide ground clearance



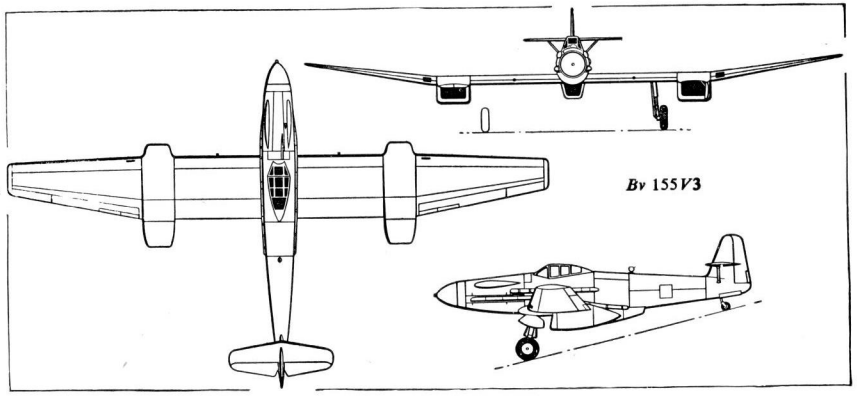
(Left and below) The Blohm und Voss Bv 155V3.



for a 2,200-lb. SC 1000 bomb. Again Messerschmitt failed to obtain an order for the aircraft, but the basic design was further developed as the Me 155B-1 to meet a specification for a high-altitude fighter.

Prototype construction of the Me 155B-1 was about to commence when, in August 1943, the R.L.M. instructed Messerschmitt to transfer all drawings to Blohm und Voss. At this time the design employed port and starboard Bf 109 wings attached to a new rectangular centre section, spanning 68 ft. 10¾ in. overall, a standard Bf 109 fuselage, tailplane and undercarriage, and vertical tail surfaces similar to those of the Me 209V5. No less than eight individual radiators were mounted underwing! The fuselage had been lengthened to provide space for a large turbo-supercharger aft of the cockpit. Dr. Vogt of Blohm und Voss considered extensive redesign essential, and although the first prototype, initially known as the Me 155B-1 and later redesignated Bv 155A-1 or Bv 155V1, retained many Bf 109 fuselage components, an entirely new laminar flow wing was adopted. Large coolant radiators were mounted above and at the extremities of the wing centre section. The main undercarriage members were adapted from those of the Ju 87D-6, and the Bv 155V1 was flown for the first time on February 8, 1945, this test being abbreviated as a result of an alarming rise in the coolant temperature shortly after take-off. Second and third flights were made on February 10th and 28th respectively, and a second prototype, the Bv 155V2, had joined the test programme on February 15th.

The Bv 155V2 was the result of further development work by Dr. Vogt's team and was intended as the first prototype for the Bv 155B series and, like the V1, was powered by a DB 603A engine. The wing radiators were underslung, the wing chord was increased and a redesigned, all-round-vision cockpit



canopy was fitted. A second B-series prototype, the Bv 155V3, was shelved when seventy-five per cent complete in favour of the Bv 155V4, the first prototype of the extensively modified Bv 155C evolved by Blohm und Voss under the project number P.205. The Bv 155V1 and V2 served to test the TK 15 supercharger which was combined with the DB 603U engine in the Bv 155V4 and offered 1,810 h.p. Wing span was reduced from 67 ft. 3 in. to 61 ft. 2¼ in., and undercarriage track from 22 ft. to 12 ft. 8 in. The Bv 155V4 was ready for flight testing in mid-April 1945, and estimated performance included a maximum speed of 363 m.p.h. at 30,000 ft. and 428 m.p.h. at 50,000 ft., but the collapse came before a test was actually made. At this time, Blohm und Voss had an order for thirty Bv 155C-0 fighters, all of which bore *Versuchs* numbers (the first being the Bv 155V4), and plans called for the completion of the Bv 155V5 in May and the V6 and V7 in June 1945. When the Allies occupied Hamburg, the semi-completed Bv 155V3 was discovered and transported to the U.K. for examination.

The specification relates to the Bv 155V2.

Type: *Single-seat High-altitude Interceptor.* **Power Plant:** *One* 1,610 *h.p. Daimler-Benz DB* 603*A twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament** (*Projected*): *One* 30-*mm. MK* 103 *or MK* 108 *with* 60 *rounds and two* 20-*mm. MG* 151 *with* 200 *r.p.g., or three MK* 103*s or MK* 108*s with* 60 *r.p.g.* **Performance:** *Maximum speed,* 261 *m.p.h. at sea level,* 373 *m.p.h. at* 32,810 *ft.,* 429 *m.p.h. at* 52,490 *ft.; time to* 52,490 *ft.,* 29 *min.; service ceiling,* 55,610 *ft.; maximum ceiling,* 56,100 *ft.* **Weights:** *Empty,* 10,734 *lb.; normal loaded,* 12,390 *lb.; maximum,* 13,263 *lb.* **Dimensions:** *Span,* 67 *ft.* 3 *in.; length,* 39 *ft.* 4½ *in.; height,* 9 *ft.* 9½ *in.; wing area,* 419.792 *sq. ft.*

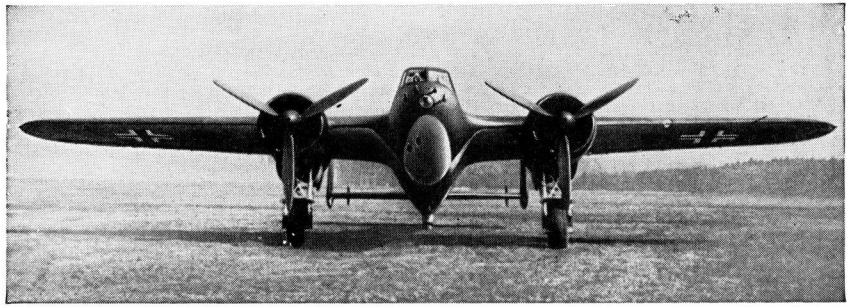
DORNIER DO 17Z-10 KAUZ II

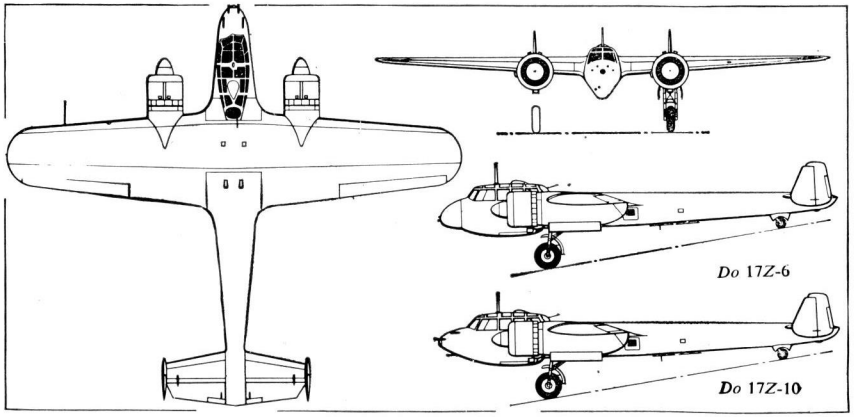
In July 1940 General Josef Kammhuber was entrusted with the task of forming the first night fighter groups or Nachtjagdgeschwader. Initially two groups were formed, NJG 1 and NJG 2, at Düsseldorf, the latter being intended primarily for the night intruder role. NJG 2 comprised three Staffeln, one of which was equipped with the Dornier Do 17Z-10 Kauz II, and, operating from Gilze Rijen in Holland, began its activities with attacks on R.A.F. Bomber Command airfields in the Home Counties, East Anglia, Lincolnshire and Yorkshire.

The Do 17Z-10 Kauz II (Screech-Owl II) was derived from the Do 17Z-6 Kauz I which was a night fighter and intruder conversion of a Do 17Z-3 reconnaissance-bomber. The standard glazed bomb-aiming nose of the Do 17Z-3 was removed and replaced by the nose of a Junkers Ju 88C-1 fighter, the cross section of which was almost identical to that of the Dornier. The standard Ju 88C-1 nose armament of three 7.9-mm. MG 17 machine guns and one 20-mm. MG FF cannon was retained, but this marriage of convenience was not entirely satisfactory and, therefore, an entirely new fuselage nose was designed, this being introduced by the Do 17Z-10, only one Do 17Z-6 being completed.

The new nose housed four 7.9-mm. MG 17 machine guns in its upper section, the ammunition containers being inserted via external hatches rather in the manner of the magazine of an automatic pistol. The lower portion of the nose contained twin 20-mm. MG FF cannon, the breeches of which protruded into the crew's compartment so that the cannon shell drums could be replaced in flight. A generally similar nose section was later to be adopted by the Do 217J-1.

In the extreme tip of the Do 17Z-10's nose was a device known as a "Spanner-Anlage" which was, in effect, an infra-red spotlight. The sighting screen, known as a "Q-Rohr", was mounted behind the starboard front windscreen and was used in conjunction with a Revi C 12/D gun-sight. The "Spanner-Anlage"





proved to be *too* sensitive and this, together with its inadequate range, resulted in its eventual replacement by early Lichtenstein SN 2 radar, the aerial array of which was generally similar to that of the Do 217J-2.

The Do 17Z-10 Kauz II normally carried a crew of four, comprising the pilot, navigator, radio-operator and radar operator. The last-mentioned crew member also served as a gunner with a single aft-firing 7.9-mm. MG 15 machine gun mounted in the rear of the cockpit. This gun could also be fixed to fire forward and upward at an oblique angle, this installation being a forerunner of the so-called "Schräge Musik" (Jazz Music) mountings employed by later Luftwaffe night fighters.

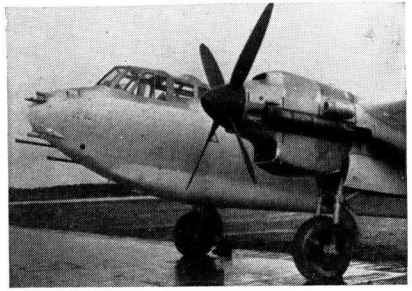
Only nine Do 17Z-10 night fighters and intruders were produced, these entering service with NJG 2 late in 1940 but proving inferior to the Junkers Ju 88C. A few Do 215B-1s were also converted to take a similar fighter nose to that of the Do 17Z-10. These were designated Do 215B-5 and differed from the Z-10 only in having 1,075 h.p. Daimler-Benz DB 601A liquid-cooled engines.

Type: *Four-seat Night Fighter and Intruder.* **Power Plants:** *Two* 1,200 *h.p. BMW-Bramo* 323*R*-2 *Fafnir nine-cylinder radial air-cooled engines.* **Armament:** *Two* 20-*mm. MG FF cannon and four fixed and one movable* 7.9-*mm. machine guns.* **Performance:** *Maximum speed,* 265 *m.p.h. at* 16,400 *ft.; maximum cruising speed,* 240 *m.p.h. at* 14,200 *ft.; service ceiling,* 26,400 *ft.; normal range,* 745 *mls.; maximum range (with auxiliary fuselage tanks),* 1,860 *mls.* **Weights:** *Empty,* 13,400 *lb.; normal loaded,* 18,830 *lb.; maximum,* 19,500 *lb.* **Dimensions:** *Span,* 59 *ft.* 0¾ *in.; length,* 53 *ft.* 3 *in.; height,* 14 *ft.* 11½ *in.; wing area,* 592 *sq. ft.*

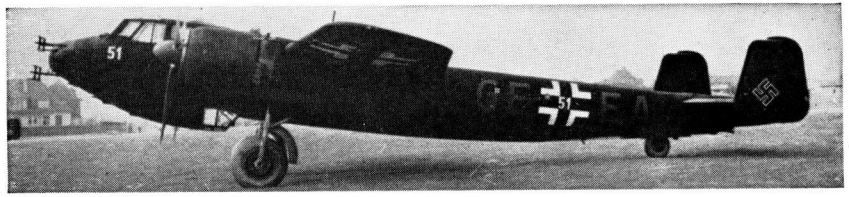
A serious shortage of night fighters and intruders which occurred in 1942 resulted in the conversion of a number of Do 217E-2 bombers to fulfil these roles. The initial conversion received the designation Do 217J-1 and was structurally similar to the bomber but featured a redesigned nose which housed a battery of four 20-mm. MG FF cannon and four 7.9-mm. MG 17 machine guns. The dorsal turret mounting one 13-mm. MG 131 machine gun was retained, and a similar gun could be mounted in the rear-firing ventral position. For intruder duties the aft bomb-bay was retained, and this normally accommodated eight 110-lb. SC 50X bombs. Later Do 217J-1 conversions were fitted with FuG 202 Lichtenstein radar which was a standard installation on the Do 217J-2, this variant being intended solely for night fighting and having all bomb-bays faired over.

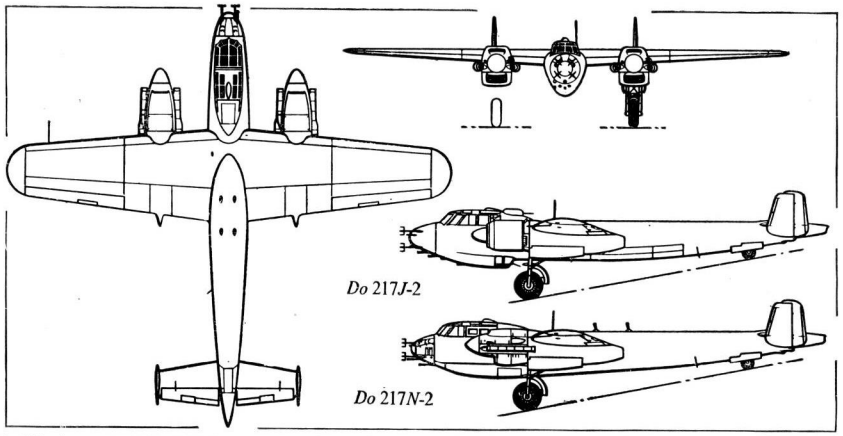
During 1942, 157 Do 217J intruders and night fighters were converted from Do 217E-2 bombers, most of the conversions being undertaken on the Friedrichshafen assembly line. A few conversions were also undertaken by maintenance units, and the Do 217J-2 became an important component of the so-called "Kammhuber Line", equipping several Nachtjagdgeschwader. With the formation of the "Forza Aerea Intercettori" by the Regia Aeronautica in 1943 for the defence of important industrial areas, a number of Do 217J-2 fighters were supplied to Italy, these being used by the 59° and 60° Gruppi.

In 1943 a second night fighter version of the basic design appeared, the Do 217N, which, converted from the Do 217M bomber, differed from the J-model principally in having DB 603A liquid-cooled engines in place of the



(*Right*) *The Do* 217*N*-2 *with radar antennae removed and* (*below*) *the Do* 217*J*-2.





1,600 h.p. BMW 801A radials. Two basic versions of the Do 217N were produced, both being equipped with FuG 101 and 202 Lichtenstein radar and carrying forward-firing armaments of four 20-mm. cannon and four 7.9-mm. machine guns. Whereas the first few Do 217N-1s differed from the Do 217J solely in the type of power plant installed, retaining the dorsal turret and provision for a rear-firing ventral gun, the Do 217N-1/U3 carried a battery of four 20-mm. MG 151 cannon in the centre fuselage, these being fixed to fire upwards at an oblique angle. Subsequently, the ventral "step" was deleted and the bomb-bay faired over. The standard 651 Imp. gal. fuel capacity could be supplemented by a 255 Imp. gal. fuselage tank. The Do 217N-2 differed from the N-1 in certain items of equipment and in having a modified cockpit canopy, and the obliquely-firing cannon (either two or four) were optional. A total of 207 Do 217J and N conversions was delivered in 1943 when production terminated. The following specification relates to the Do 217N-2.

Type: *Three-seat Night Fighter.* **Power Plants:** *Two* 1,750 *h.p. Daimler-Benz DB* 603*A twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Four* 20-*mm. MG* 151 *cannon and four* 7.9-*mm. MG* 17 *machine guns in nose.* **Performance:** *Maximum speed,* 267 *m.p.h. at sea level,* 320 *m.p.h. at* 19,685 *ft.; maximum cruising,* 292 *m.p.h. at* 17,715 *ft.; economical cruising,* 264 *m.p.h. at* 17,715 *ft.; time to* 13,125 *ft.,* 9 *min., to* 19,685 *ft.,* 15 *min.; service ceiling,* 29,200 *ft.; maximum range,* 1,550 *mls.* **Weights:** *Empty equipped,* 20,700 *lb.; normal loaded,* 29,100 *lb.* **Dimensions:** *Span,* 62 *ft.* 4 *in.; length,* 58 *ft.* 9 *in.; height,* 16 *ft.* 3 *in.; wing area,* 610 *sq. ft.*

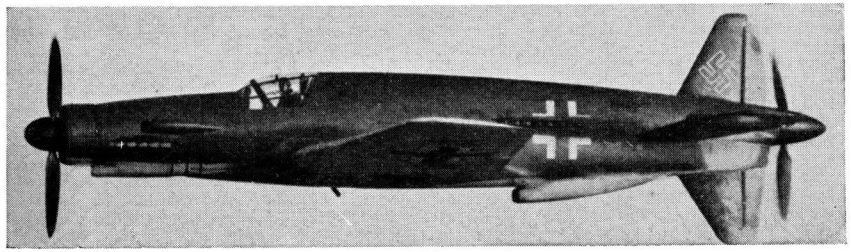
DORNIER DO 335 PFEIL

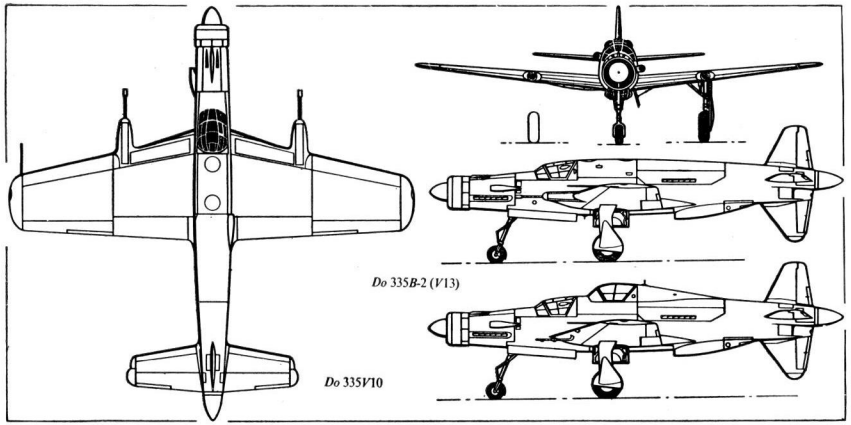
The most unconventional piston-engined fighter to be developed by the German aircraft industry during the war was, without doubt, the Do 335 Pfeil (Arrow) which featured one engine in the nose driving an orthodox tractor airscrew and a second engine amidships in the fuselage driving a pusher airscrew behind the tail. This unique configuration was patented by Dr. Claude Dornier in 1937, and to provide data on the effects of a pusher airscrew driven by an extension shaft and mounted aft of a cruciform tail, a small experimental aircraft, the Gö 9, embodying these features, was built by Schemp-Hirth at Wüsterberg, and was flown in 1940 with an 80 h.p. Hirth HM 60R engine.

Tests with the Gö 9 confirmed the feasibility of the arrangement, and the Dornier design team began work on the Do 231 single-seat intruder which carried a 2,200-lb. bomb load internally. Changes in operational requirements resulted in the cancellation of the Do 231, and in 1942 the design was reworked as the Do 335, the first prototype, the Do 335V1, a single-seater powered by two 1,800 h.p. DB 603E engines, flying for the first time in the autumn of 1943. At this time, thirty-eight aircraft had been ordered: fourteen *Versuchs* (experimental) machines, ten pre-production Do 335A-0s, eleven Do 335A-1s, and three two-seat conversion trainer models (A-10 and A-12). The Do 335V2 was similar to the V1 but was destroyed at Oberpfaffenhofen during manufacturer's trials, and the V3 was also similar, but the V4 was intended to serve as a test-bed for a more advanced development of the basic design, the Do 435 side-by-side two-seat night fighter powered by Jumo 222 engines. The Do 335V5 was the first prototype to carry armament and was used for trials at Tarnewitz, having twin 15-mm. MG 151 cannon mounted over the forward engine and a 30-mm. MK 103 cannon firing through the airscrew boss; the V6 and V7 were retained by Dornier as test airframes, and the V8 was delivered to Daimler-Benz's flight test division.

Apart from the Do 335V4, all these prototypes were single-seaters, as was also the Do

(*Below*) *The Do* 335*V*1 *was flown for the first time in the autumn of* 1943.





335V9 production prototype delivered to the Rechlin test centre for official trials in the summer of 1944. By this time the ten pre-production Do 335A-0 fighter-bombers had reached an advanced stage of assembly, and began to join the test programme in the autumn of 1944. These were single-seat fighter-bombers carrying a 1,100-lb. bomb load, one 30-mm. MK 103 and two 15-mm. MG 151 cannon. The initial production model, the Do 335A-1 Pfeil single-seat day and night fighter-bomber, differed principally in having 1,900 h.p. DB 603G engines, and these were delivered in January–February 1945, although service pilots experienced some difficulty in handling the aircraft, which were prone to "porpoising" and "snaking" at high speeds. The Do 335A-4 was a reconnaissance variant with two RB 50/30 cameras.

Several two-seat variants of the Pfeil were being developed in parallel with the single-seater, including the Do 335V10 with 1,750 h.p. DB 603A-1 engines, the second cockpit for the radio and radar operator being installed immediately behind and slightly above that of the pilot, FuG 217J radar antennae being attached to the wing leading edges. The V11 and V12 were also two-seaters, these serving as prototypes for the Do 335A-10 and A-12 conversion trainers.

During the closing stages of the war, work had commenced on the B-series intended specifically for the heavy day fighter and night fighter roles. The Do 335V13 and V14 were prototypes for the single-seat Do 335B-2 destroyer which, powered by DB 603E engines, differed from the A-1 principally in having a heavier forward-firing armament, a 30-mm. MK 103 cannon being mounted in the leading edge of each wing, the total armament being

three MK 103s and two 20-mm. MG 151s. The installation of the wing-mounted MK 103s was unusual in that the complete cannon hinged downward, pivoting on the forward extremity of the fairing, to simplify maintenance. Several other B-series variants were planned when the Oberpfaffenhofen plant was occupied by the Allies. These included the Do 335B-3 which was similar to the B-1 apart from the use of DB 603LA engines with two-stage superchargers and rated at 2,100 h.p. for take-off; the Do 335B-4 which, in order to make the best use of the high altitude characteristics of the DB 603LA engine, employed a redesigned wing of higher aspect ratio spanning 60 ft. 4½ in.; the Do 335B-6 two-seat night fighter similar to the A-6; the Do 335B-7 similar to the B-6 apart from the use of DB 603LA engines, and the Do 335B-8 with the enlarged wing of the B-4. Another projected development was the Do 635 which comprised two Do 335s connected by a new centre section between the fuselages. In the long-range reconnaissance role, the Do 635 was expected to attain an ultimate range of 4,050 miles at 398 m.p.h. at 21,300 ft.

At the end of the war a few Do 335A-1 single-seaters had been delivered to the Luftwaffe, but these were not encountered operationally. The following specification relates to this model.

Type: *Single-seat Fighter-bomber.* **Power Plants:** *Two* 1,900 *h.p. Daimler-Benz DB* 603*G twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *One* 30-*mm. MK* 103 *cannon with* 70 *rounds and two* 15-*mm. MG* 151 *cannon with* 200 *r.p.g. plus* 1,100-*lb. bomb load.* **Performance:** *Maximum speed,* 413 *m.p.h. at* 26,200 *ft.; service ceiling,* 37,400 *ft.; maximum range* (398 *Imp. gal. internally and* 527 *Imp. gal. in external tank*), 2,330 *mls. at* 385 *m.p.h. at* 19,680 *ft.; normal range,* 1,280 *mls. at* 295 *m.p.h. at* 19,680 *ft.* **Weights:** *Empty,* 16,314 *lb.; normal loaded,* 21,186 *lb.; maximum,* 25,800 *lb.* **Dimensions:** *Span,* 45 *ft.* 3⅛ *in.; length,* 45 *ft.* 5¼ *in.; height,* 16 *ft.* 4¾ *in.; wing area,* 414.41 *sq. ft.*

(Below) The second pre-production Do 335*A*-0 *fighter. Ten Do* 335*A*-0*s were completed.*

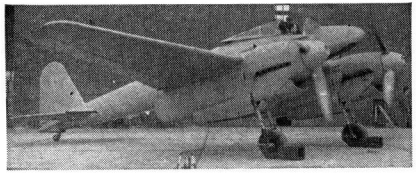
FOCKE-WULF FW 187A FALKE

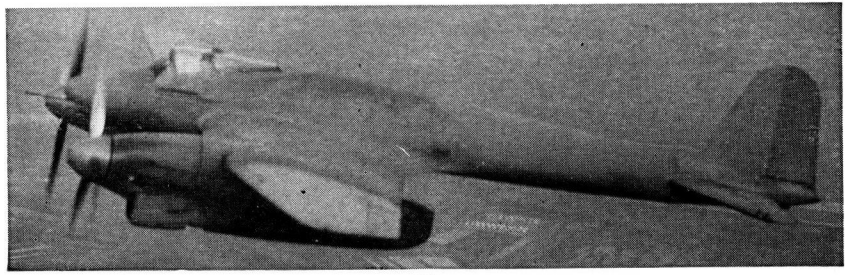
GERMANY

Early in 1936, Dipl. Ing. Kurt Tank of the Focke-Wulf Flugzeugwerke began the design of a single-seat twin-engined fighter which, it was anticipated, would attain 348 m.p.h. with two 960 h.p. Daimler-Benz DB 600 engines. Limited support for the project was provided by the R.L.M. which ordered three prototypes, the fighter receiving the type number "Fw 187", and the name Falke (Falcon) being given to the aircraft by its manufacturer. As no DB 600 engines were available for installation in the prototypes of the Falke, the Fw 187V1 (D-AANA) was fitted with two 635 h.p. Junkers Jumo 210Ds and flown in the summer of 1937. Despite the fact that the Fw 187V1 possessed some thirty-five per cent less power than that originally envisaged by its designer, it attained a maximum speed of 325 m.p.h., and, for a twin-engined fighter, possessed a commendable turning circle and exceptional diving and climbing characteristics. The first prototype was fitted with both single and twin mainwheel members during its trials, and armament was to have comprised two forward-firing 7.9-mm. guns.

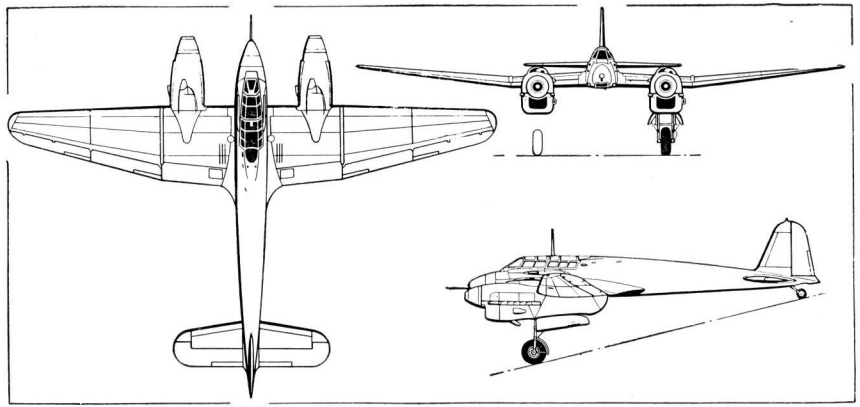
The Fw 187V2 was generally similar to the first prototype apart from having 670 h.p. Jumo 210G engines, but the Fw 187V3 (D-ORHP) was completed as a two-seater as no official requirement existed for a twin-engined single-seater. The armament of the Fw 187V3 was increased to four forward-firing 7.9-mm. guns, and the nacelles of the Jumo 210G engines were cut back at the rear to allow the fitting of unbroken flaps. The three prototypes were exhaustively tested, but the Fw 187V1 was destroyed on May 14, 1938, as the result of a control failure during the recovery from a dive.

Although R.L.M. interest in the Falke was still little more than lukewarm, three further two-seat prototypes were ordered, the first two of these, the Fw 187V4 (D-OSNP) and V5 (D-OTGN), having Jumo 210G engines, and the last prototype, the Fw 187V6, having 1,000 h.p. Daimler-Benz DB 600A engines with surface evaporation cooling. The Fw 187V6, which was flight tested during the summer of 1939, attained what was for that time the phenomenal maximum speed of 390 m.p.h., but the surface evaporation cooling proved unreliable. In the meantime, the R.L.M. had ordered the construction of three pre-production Falke fighters which were designated Fw 187A-0. These were generally similar to the Fw 187V4 and V5, but a flat windscreen replaced the free blown windscreen of the

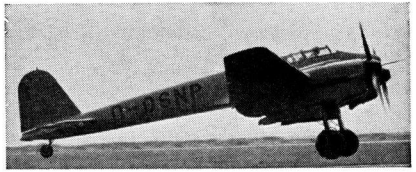


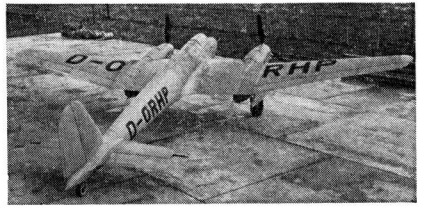


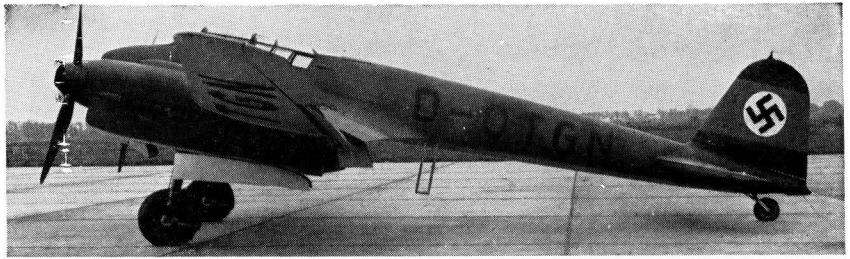
(*Left*) *The Fw* 187*V*1 *and* (*below*) *the Fw* 187*V*2.



(*Top*) *The Fw* 187*V*4 *and* (*bottom*) *the Fw* 187*V*3.





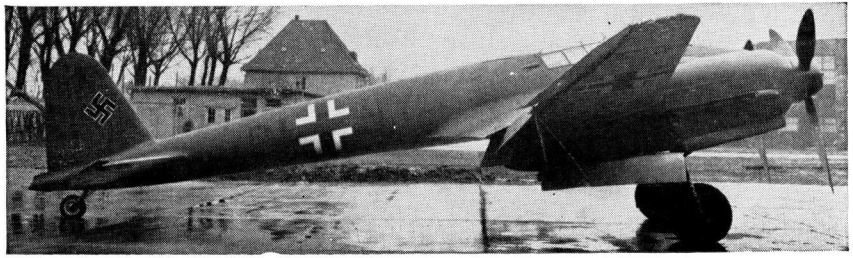


(*Above*) *The Fw* 187*V5 and* (*below*) *the Fw* 187*V6 which, with DB* 600*A engines, attained* 390 *m.p.h.*

prototypes, and forward-firing armament was supplemented by a pair of 20-mm. cannon.

Completed early in 1940, the three Fw 187A-0 fighters were used for the protection of Focke-Wulf's Bremen plant during that summer, being flown by company test pilots. During the following winter, the three fighters were unofficially "loaned" to a Luftwaffe unit based in Norway. The service pilots were delighted with the machines, but immediately the R.L.M. learned of their illicit use they were withdrawn. No production orders for the Falke fighter were placed, and the pre-production machines subsequently served as test-beds for the Ta 154.

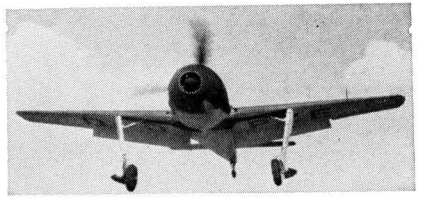
Type: *Two-seat Interceptor Fighter.* **Power Plants:** *Two* 700 *h.p. Junkers Jumo* 210*G twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Four* 7.9-*mm. MG* 17 *machine guns and two* 20-*mm. MG FF cannon.* **Performance:** *Maximum speed,* 326 *m.p.h. at* 13,800 *ft.; service ceiling,* 32,800 *ft.* **Weights:** *Empty,* 8,160 *lb.; loaded,* 11,000 *lb.* **Dimensions:** *Span,* 50 *ft.* 2⅜ *in.; length,* 36 *ft.* 5 *in.; height,* 12 *ft.* 7½ *in.; wing area,* 327.222 *sq. ft.*



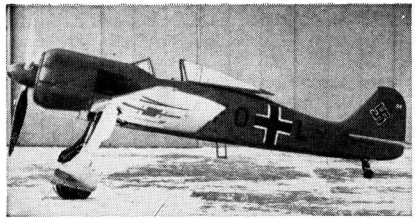
FOCKE-WULF FW 190A

The Fw 190 was designed as a result of a development contract placed by the R.L.M. with the Focke-Wulf Flugzeugbau in the autumn of 1937 for a new single-seat fighter. Project drawings for fighters employing both the liquid-cooled DB 601 inline engine and the BMW 139 air-cooled radial were prepared, and instructions to proceed with the latter fighter were issued in the summer of the following year. The first prototype, the Fw 190V1 (D-OPZE), was flown on June 1, 1939, powered by a fan-cooled 1,550 h.p. BMW 139 engine. An unusual feature was the use of a ducted spinner to reduce the drag of the bulky radial engine. After five test flights, the Fw 190V1 was transferred to the Rechlin test centre where it attained a speed of 370 m.p.h. in level flight.

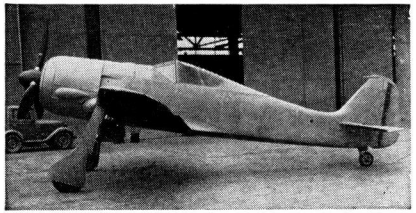
The Fw 190V1 possessed excellent handling characteristics and was highly manoeuvrable.



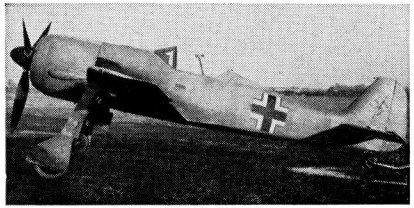
(*Below and right*) *The Fw* 190*V*1 *with ducted spinner.*



The modified first prototype, the Fw 190*V*1.



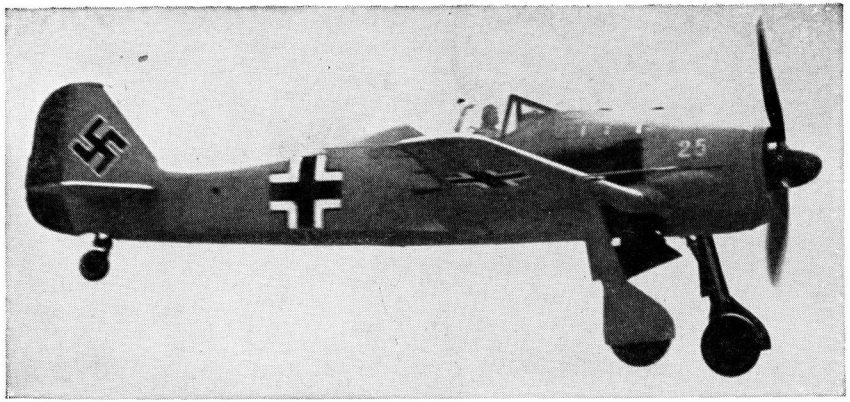
The Fw 190*V5k with* 31 *ft.* 2 *in. wing-span.*



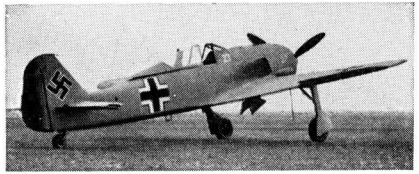
The Fw 190*V5g with enlarged wings of* 34 *ft.* 5½ *in. span which increased manoeuvrability.*

but the ducted spinner resulted in some engine overheating, and this was, therefore, removed and replaced by a more orthodox, close-fitting, low-drag cowling. The second prototype, the Fw 190V2, was fitted with an armament of two 13-mm. MG 131 and two 7.9-mm. MG 17 machine guns in the wings, and was used for armament trials at Tarnewitz. Loaded weight of the Fw 190V2 had increased to 4,410 lb. from the 3,968 lb. of the first prototype.

In June 1939, shortly after the Fw 190V1's first flight, it was decided to abandon the BMW 139 engine in favour of the newer BMW 801 which, although appreciably heavier than its predecessor, had greater development potential and possessed similar dimensions. Construction of the Fw 190V3 was, therefore, terminated and the Fw 190V4 abandoned, and the fighter redesigned to accommodate the BMW 801. One of the faults displayed by the Fw 190V1 and V2 was the close proximity of the engine to the cockpit with consequent high cabin temperatures and seepage of exhaust fumes. The opportunity was thus taken to relocate the cockpit further aft, a change which simultaneously solved c.g. problems presented by the heavier engine and eliminated the problems concerning cabin temperatures and the intrusion of exhaust gases. The next two prototypes were designated Fw 190V5k and Fw 190V5g (the "k" and "g" suffixes indicating *klein*, or small, and *gross*, or large, respectively), the former having a 31 ft. 2 in. wing-span with an area of 160 sq. ft., similar to that of the first two prototypes, and the latter having a wing spanning 34 ft. 5½ in. and an area of 196.98 sq. ft. The Fw 190V5k flew during the spring of 1940, and proved to be only 6 m.p.h. faster than the V5g with the larger wing which markedly benefited manoeuvrability. The Fw 190V6, which flew in October 1940, was essentially similar to the Fw 190V5g.

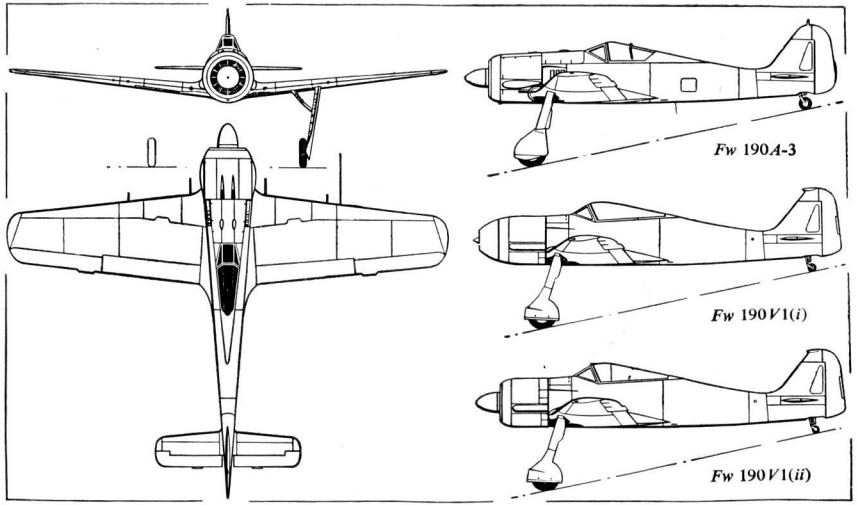


(*Above*) *The last Fw* 190*A*-0 *and* (*right*) *the second production Fw* 190*A*-1 *Würger.*



In the meantime, construction of a pre-production batch of eighteen Fw 190A-0 fighters had been commenced for service evaluation, the first seven of these (Werk-Nrs. 0008 to 0014 inclusive) having the short-span wings and the remainder (Werk-Nrs. 0015 to 0025 inclusive) having the long-span wings. These were powered by the 1,600 h.p. BMW 801C, and, delivered during the winter of 1940–41, were mostly sent to Rechlin-Rogenthin for pre-service trials. The Fw 190A-0 carried an armament of four 7.9-mm. MG 17 machine guns, and the later machines were similar to the initial production Fw 190A-1 which was known unofficially as the *Würger* (Butcher Bird). Also powered by the BMW 801C, the Fw 190A-1 began to leave the assembly lines at Bremen and Hamburg late in 1940, and the initial batch of 100 machines was completed by the late spring of 1941.

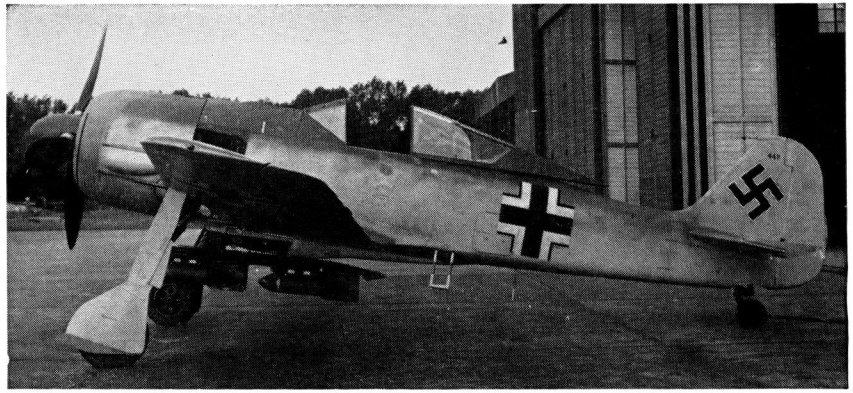
The Fw 190A-1s were tested under operational conditions by Luftwaffe squadrons, and the principal complaint was that of inadequate fire power. This had been foreseen, however, and the Fw 190A-2 which had succeeded the A-1 on the assembly lines had two 20-mm. MG FF cannon in place of the inboard MG 17 machine guns. This armament was later supplemented by two additional MG 17s, and



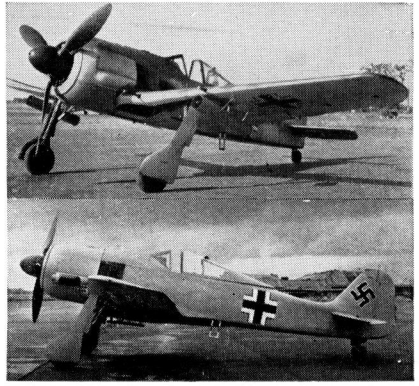
loaded weight was increased from 7,055 lb. to 7,716 lb. Maximum speed was 389 m.p.h. at 18,000 ft. The first Fw 190A-2s were delivered to a Jagdstaffel based on Le Bourget in May 1941, and during the summer the fighter appeared in action with Jagdgeschwader 26 commanded by Adolf Galland and based on the Channel coast.

The Fw 190A immediately manifested a marked superiority over the Spitfire V, but the BMW 801C engine suffered numerous teething troubles and the slow-firing MG FF cannon were generally unsatisfactory. Thus, after the completion of relatively few Fw 190A-2s, a new version appeared in production in the autumn of 1941. This, the Fw 190A-3, was powered by the improved BMW 801Dg engine rated at 1,700 h.p. for take-off, and the MG FF cannon previously mounted in the wing roots were mounted outboard and supplanted in their original position by a pair of faster-firing 20-mm. MG 151 cannon, total armament thus becoming four 20-mm. cannon and two 7.9-mm. MG 17 machine guns. By the end of 1941, a total of 210 Fw 190A fighters had been delivered.

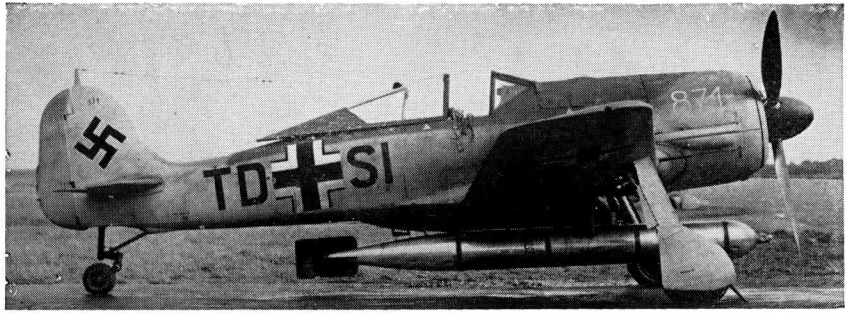
Production tempo increased rapidly, and early in 1942 the Fw 190 accounted for more

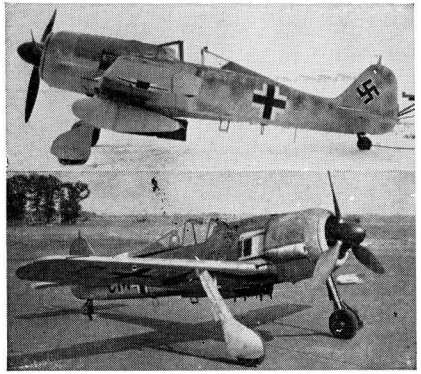


(Above) An Fw 190A-3 converted for fighter-bomber trials. (Right) An Fw 190A-4/R6 with 21-cm. rocket tubes, and (below, right) an Fw 190A-3 used for testing tropical filters.



than half the total single-engined fighter output of 500 aircraft per month: and in mid-1942 the Fw 190A-4 made its appearance. This differed from its immediate predecessor primarily in having a supplementary fuel injection system (MW 50) for its BMW 801D-2 engine which boosted maximum power to 2,100 h.p. for brief periods and increased maximum speed to 416 m.p.h. at 20,600 ft. A tropicalised version for use in the Mediterranean was designated Fw 190A-4/Trop. This featured tropical filters and a rack for a 550-lb. bomb under the fuselage. The A-4/R6 had no MW 50 power boost equipment but could carry a WG 21 rocket missile tube under each wing, while the A-4/U8 was a specialised long-range





(Above) The experimental Fw 190A-5/U15 torpedo-fighter. (Left) An Fw 190A-5/U8 with underwing tanks, and (below, left) an Fw 190A-5/U3 Trop.

fighter-bomber which, carrying a 66 Imp. gal. drop tank under each wing, could carry a single 1,100-lb. bomb under the fuselage. Built-in armament was reduced to two 20-mm. MG 151 cannon.

By the end of 1942 production totalled 1,918 aircraft, and the equipment of the single-engined fighter elements of the Luftwaffe was now divided almost equally between the Fw 190 and the Bf 109. The next production model, the Fw 190A-5, was essentially similar to the A-4 but embodied a redesigned engine mount which carried the BMW 801D-2 engine 5.9 inches further forward. Numerous sub-variants of this model were evolved, such as the Fw 190A-5/U2 night fighter which, fitted with anti-dazzle screens and flame shrouds over the exhausts, was used for *Wilde Sau* (Wild Boar) tactics—a form of free-lance night fighting with the aid of searchlights—by Jagdgeschwader 300 formed in July 1943, and subsequently by J.G. 301 and 302.

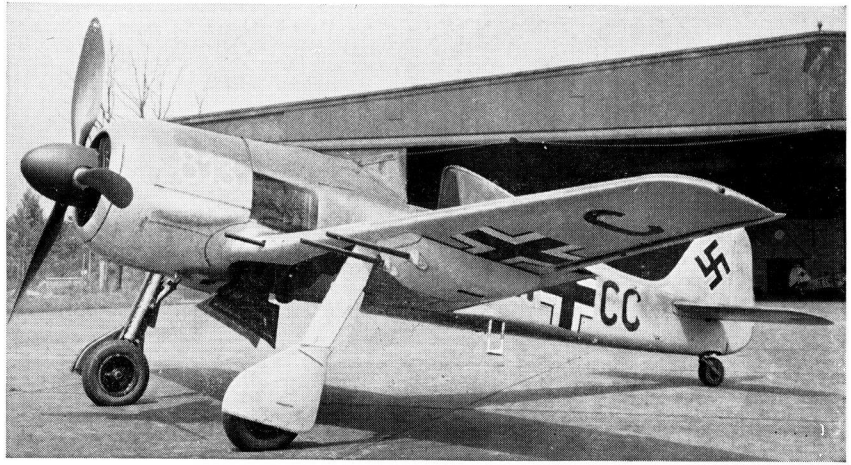
The Fw 190A-5/U3 was a fighter-bomber carrying a bomb load of up to 2,200 lb. and a defensive armament of only two 20-mm. MG 151 cannon; the A-5/U8 was a long-range

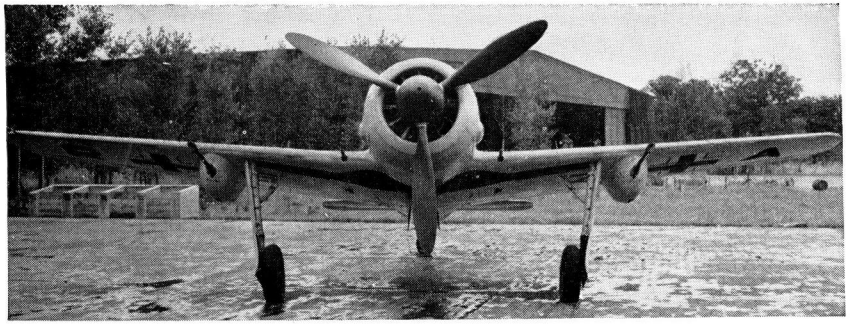
version with faired 66 Imp. gal. underwing drop tanks; the A-5/U11 was a ground-support model which, appearing in November 1943, carried two 30-mm. MK 103 cannon outboard; the A-5/U15 was a special torpedo-fighter with a rack for a single 2,090-lb. LT 950 torpedo, and the A-5/U16 was a special bomber destroyer with 30-mm. MK 108 cannon outboard.

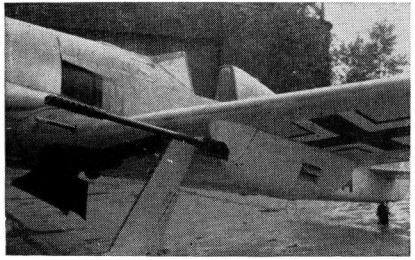
The Fw 190A-6 featured some structural lightening and was an interceptor fighter with four MG 151s and two MG 17s, and the A-6/R2 was a fighter-bomber variant of this production model. The Fw 190A-7 denoted a further armament change, the paired guns in the engine cowling becoming 13-mm. MG 131s, and a strengthened undercarriage was fitted. The A-7/R2 and R3 were respectively fitted with MK 108 cannon outboard and shackles for a 66 Imp. gal. drop tank.

The Fw 190A-8 introduced at the end of 1943 had an increase in internal fuel capacity of 25 Imp. gal., and sub-variants included the A-8/R1 with four MG 151s mounted in pairs in underwing gondolas; the A-8/R3 ground-support version with two outboard MK 103s, and the A-8/R11 "dirty weather" fighter with special radio and navigational equipment. The Fw 190A-8/U1, first flown on January 23, 1944, was a two-seat conversion trainer, and the A-8/U11 was a fighter-bomber carrying one 550-lb. bomb and four 110-lb. bombs.

The Fw 190A-8/R1 carried four 20-mm. MG 151 cannon in underwing trays.







The Fw 190A-8/R3 carried 30-mm. MK 103s outboard.

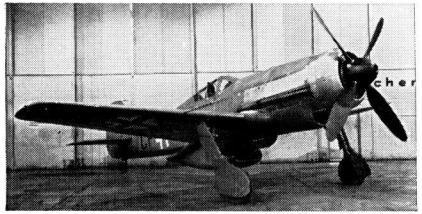
The Fw 190A-9 differed solely in having a 2,000 h.p. BMW 801F, and the A-9/R11 was a "dirty weather" fighter similar to the A-8/R11 but with a BMW 801TS engine with an exhaust-driven turbo-supercharger. The final A-series production model was the Fw 190A-10 which, fitted with a BMW 801T engine, could carry three 66 Imp. gal. drop tanks for long-range escort or a 3,860-lb. bomb load.

Apart from prototypes, 13,367 Fw 190 fighters and 6,634 Fw 190 fighter-bombers and close-support aircraft were produced, the majority of these being A-series aircraft. The accompanying specification relates to the Fw 190A-8.

Type: *Single-seat Fighter.* **Power Plant:** *One* 1,700 *h.p.* (2,100 *h.p. with MW* 50 *boost*) *BMW* 801*D*-2 *fourteen-cylinder air-cooled radial engine.* **Armament:** *Two* 13-*mm. MG* 131 *machine guns and four* 20-*mm. MG* 151 *cannon.* **Performance:** *Maximum speed,* 408 *m.p.h. at* 20,600 *ft.,* 402 *m.p.h. at* 18,000 *ft.,* 355 *m.p.h. at sea level; normal cruising speed,* 298 *m.p.h.; range (internal fuel),* 500 *mls.; initial climb rate,* 2,350 *ft./min.; service ceiling,* 37,400 *ft.* **Weights:** *Empty,* 7,000 *lb.; loaded,* 9,750 *lb.; maximum,* 10,800 *lb.* **Dimensions:** *Span,* 34 *ft.* 5½ *in.; length,* 29 *ft.* 0 *in.; height,* 13 *ft.* 0 *in.; wing area,* 196.98 *sq. ft.*

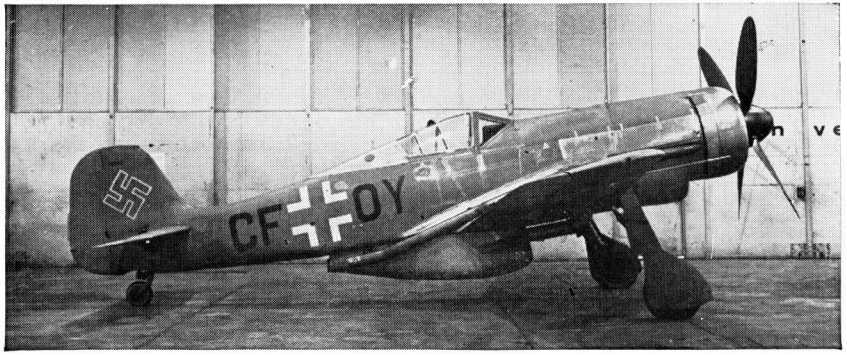
FOCKE-WULF FW 190B

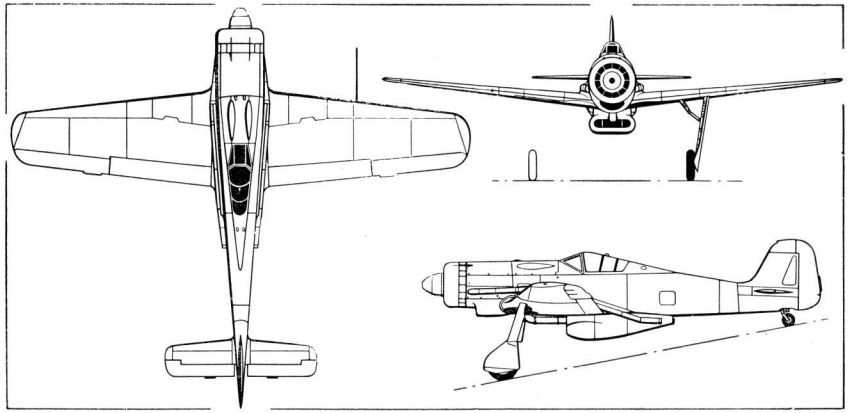
At a relatively early stage in the development of the Focke-Wulf Fw 190 fighter thought was given to the adaptation of the basic design for fighting at extreme altitudes. The proposed high-altitude version was designated Fw 190B, and the first prototype, the Fw 190V13, was essentially similar to the Fw 190A-1 with the BMW 801C radial air-cooled engine apart from the introduction of a nitrous oxide power-boost system (GM 1) which was used above the rated altitude of the engine, and a pressurized cockpit for the pilot.



Three further prototypes were built during 1942–43, and these, intended to serve as pre-production aeroplanes, were powered by the Daimler-Benz DB 603 twelve-cylinder inverted-Vee liquid-cooled engine with annular radiator. The first of these prototypes had a standard DB 603E engine with a normal mechanically-driven supercharger and three-bladed airscrew, but subsequent prototypes had large, belly-mounted Focke-Wulf turbo-superchargers which resulted in the Fw 190B being dubbed the *Kānguruh* (Kangaroo). A four-blade airscrew was adopted in order to make efficient use of the additional power available, and altitudes considerably in excess of 40,000 ft. were attained during the flight test programme.

The DB 603-powered prototypes were tested





throughout 1943 and the early months of 1944, initially without cockpit pressurization, but numerous teething troubles were experienced and a further six prototypes were built (the Fw 190V18/U1, V29, V30, V31, V32 and V33) for further trials and operational evaluation. By this time, however, the Jumo 213-powered Fw 190D series of fighters had reached production status, and their performances were such that further development of B-series fighters was abandoned.

The first DB 603-powered Fw 190B prototype.

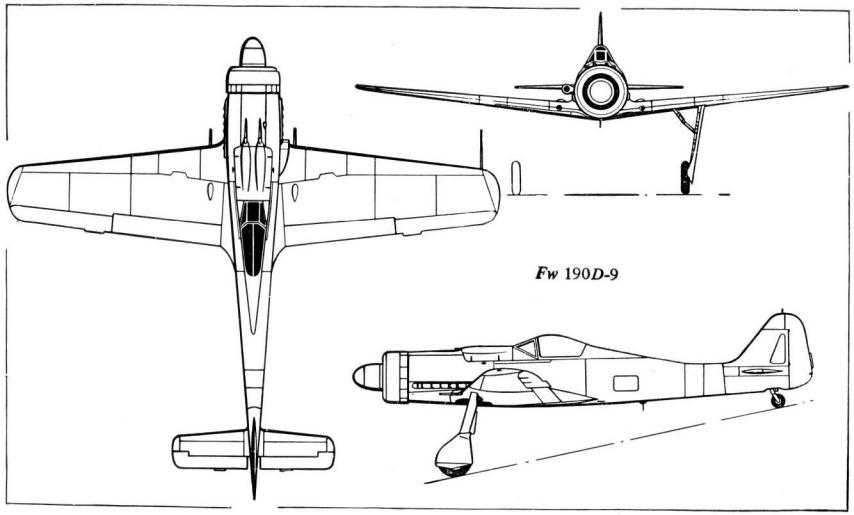
Type: *Single-seat High-altitude Interceptor Fighter.* **Power Plant:** *One* 1,800 *h.p. Daimler-Benz DB* 603 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament** (*proposed*)**:** *One* 30-*mm. MK* 108 *cannon firing through the airscrew boss, two* 13-*mm. MG* 131 *machine guns and two* 20-*mm. MG* 151 *cannon.* **Performance:** *Maximum speed,* 415 *m.p.h. at* 35,500 *ft.,* 352 *m.p.h. at sea level; service ceiling,* 39,400 *ft.* **Weights:** *Approximate loaded,* 10,000 *lb.* **Dimensions:** *Span,* 34 *ft.* 5½ *in.; length,* 32 *ft.* 0 *in.; height,* 13 *ft.* 0 *in.; wing area,* 196.98 *sq. ft.*

FOCKE-WULF FW 190D

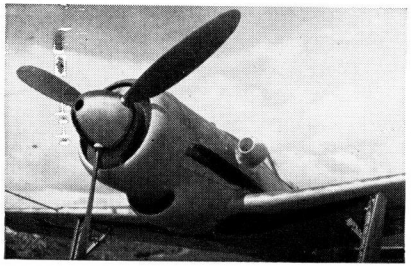
The Fw 190, perhaps the most successful of Germany's wartime fighters, was subjected to continuous development in order to keep pace with the rapidly changing requirements of the air war. Before the type had entered widespread service in its initial form work on adapting the basic airframe to take liquid-cooled engines and improving the high altitude capabilities of the fighter was being undertaken by the Focke-Wulf design team led by Professor Dipl. Ing. Kurt Tank. Work on three high altitude interceptor variants powered by liquid-cooled engines was inaugurated almost simultaneously. The first of these was the Fw 190B with the Daimler-Benz DB 603 engine, this being followed by the similarly-powered Fw 190C which featured an extended wing spanning 35 ft. 7 in., and the Fw 190D powered by the Junkers Jumo 213. The last-mentioned type proved easily the most effective of the trio, development of the B- and C-series eventually being abandoned in its favour.

The first prototypes to be fitted with the Jumo 213A were the Fw 190V17 and V18 which, commencing flight trials during the winter of 1941–42, were conversions of pre-production Fw 190A-0 aircraft. Their spectacular performance resulted in the conversion of a further five machines to take the Jumo, these being designated Fw 190V20, V21, V22, V23 and V25, and parallel work was started on a small pre-production batch of Fw 190D-0 fighters converted from Fw 190A-7 airframes and intended for service evaluation. The Fw 190D-0 employed the wing, undercarriage and

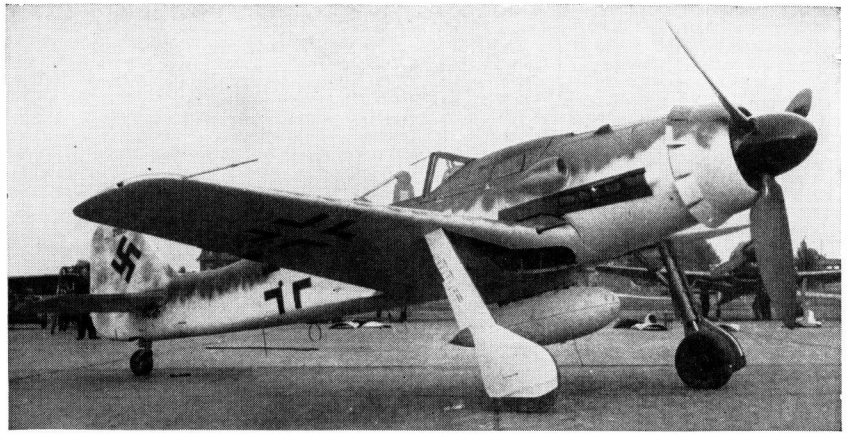
An Fw 190D prototype with A-series rear fuselage and vertical tail surfaces.



The DB 603-powered Fw 190C.



tail-assembly of the radial-engined Fw 190A, and much of the fuselage was unchanged, but the Jumo 213A-1 was installed as a complete power egg attached by four bolts to the fire-proof bulkhead and employed an annular radiator. To compensate for the lengthened nose a parallel section was inserted in the rear fuselage. Armament of the Fw 190D-0 remained the same as that of the Fw 190A-7, comprising four wing-mounted 20-mm. MG 151 cannon and two 13-mm. MG 131 machine guns mounted over the engine. The installation of a 30-mm. MK 108 cannon firing through



An early production Fw 190D-9 with original style cockpit canopy.

the airscrew boss was considered, but the use of a V.S.111 airscrew prevented this.

Small batches of pre-production Fw 190D-0s and production Fw 190D-1s for service evaluation were delivered and tested during the spring and summer of 1943, the D-1 differing from pre-production models solely in having an enlarged vertical fin, the area of which was increased by 2.5 ft. by moving the stern post. The Fw 190D-1 was not manufactured in large numbers, the first major production model being the Fw 190D-9 which became operational with J.G.3 (Jagdgeschwader Udet) at Detmold in the winter of 1943–44, and proved an immediate success. The Fw 190D-9 had the outboard 20-mm. MG 151 cannon removed and provision made for MW 50 (methanol-water) power boost which raised the power of the Jumo 213A-1 from 1,776 h.p. to 2,240 h.p. for take-off. The methanol-water mixture was carried in a 25 Imp. gal. tank aft of the cockpit and was sufficient for some 40 minutes' use.

For some unexplained reason no sub-series suffix numerals between D-1 and D-9 were allocated, and the Fw 190D-9 was the only D-series fighter intended solely for the interception role. The Fw 190D-11 was an interim ground-attack model similar to the D-9 apart from having two wing-mounted 30-mm. MK 108 cannon outboard of the MG 151s, and the first version intended from the outset for ground-attack was the Fw 190D-12 powered by a Jumo 213F with a three-stage super-

charger and rated at 2,060 h.p. for take-off. The D-12 had a 30-mm. MK 108 cannon firing through the airscrew boss and considerable armour around the engine. The Fw 190D-12/R11 had an automatic pilot and FuG 125 "Hermine" D/F navigation equipment for bad-weather operation, and the Fw 190D-12/R5 had additional fuel tankage, the extra tanks being installed in the wings. Although primarily a ground-attack machine, the Fw 190D-12 also made an effective fighter and, with the aid of MW 50 boost, attained 453 m.p.h. at 37,000 ft. The Fw 190D-13 differed from the D-12 in having a Jumo 213EB engine and in discarding the engine-mounted MK 108 for a 20-mm. MG 151 in the same position. The Fw 190D-13/R5 carried a TSA 2D bomb-aiming device, and with eight 110-lb. SC 50 bombs weighed 11,288 lb. The Fw 190D-14 and -15 were respectively proposed versions powered by the Daimler-Benz DB 603A and EB engines, which were eventually developed into the Ta 152C.

The following specification relates to the Fw 190D-9.

Type: *Single-seat Interceptor and Fighter-bomber.* **Power Plant:** *One* 1,770 *h.p.* (2,240 *h.p. with MW* 50) *Junkers Jumo* 213*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. MG* 151 *cannon with* 250 *r.p.g. and two* 13-*mm. MG* 131 *machine guns with* 475 *r.p.g.* **Performance:** *Maximum speed (with MW* 50), 357 *m.p.h. at sea level,* 397 *m.p.h. at* 10,827 *ft.,* 426 *m.p.h. at* 21,653 *ft.,* 397 *m.p.h. at* 32,810 *ft.; climb to* 6,560 *ft.,* 2.1 *min., to* 13,120 *ft.,* 4.5 *min., to* 19,685 *ft.,* 7.1 *min., to* 32,810 *ft.,* 16.8 *min.; normal range,* 520 *mls. at* 18,500 *ft.* **Weights:** *Empty,* 7,694 *lb.; normal loaded,* 9,480 *lb.; maximum,* 10,670 *lb.* **Dimensions:** *Span,* 34 *ft.* 5⅓ *in.; length,* 33 *ft.* 5¼ *in.; height,* 11 *ft.* 0¼ *in.; wing area,* 196.979 *sq. ft.*

An Fw 190*D*-12 *ground attack fighter photographed at Rhein-Main airfield in* 1945.

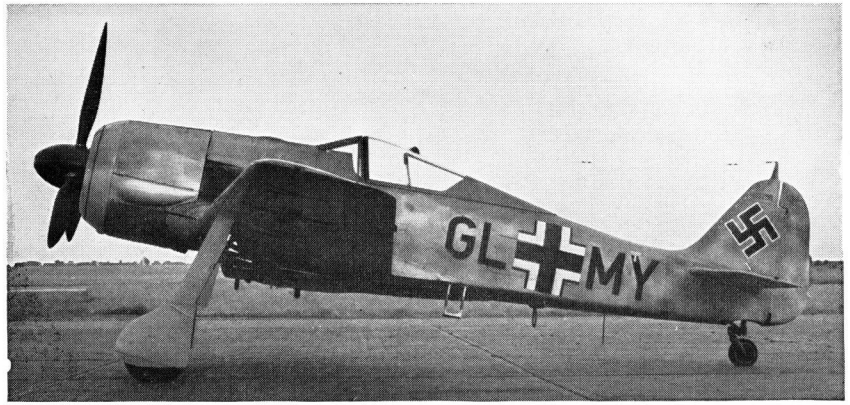
FOCKE-WULF FW 190F AND FW 190G

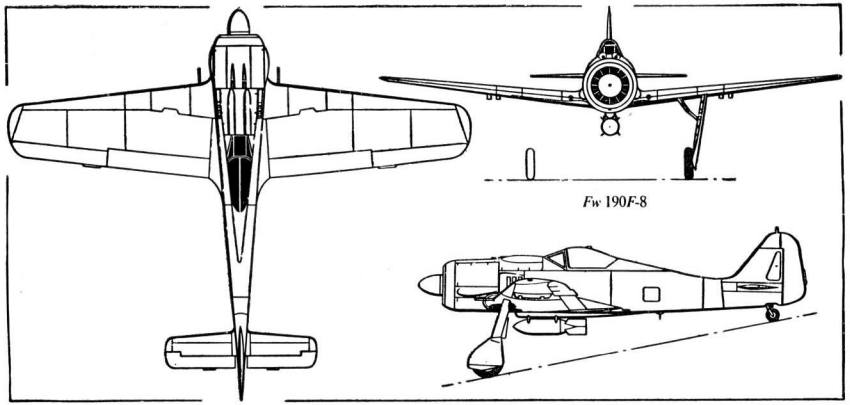
Although the Fw 190 was designed principally as an interceptor, the basic airframe proved amenable to adaptation for numerous other roles, among the most important of which were those of close-support fighter, fighter-bomber, and fighter-dive-bomber. The Fw 190A-4/Trop had been fitted with a rack to carry a single 550-lb. bomb, and the A-4/U8 with reduced gun armament carried a similar load plus two 660 Imp. gal. drop tanks. The success of these adaptations prompted the development of further fighter-bomber variants such as the Fw 190A-5/U3 which carried a 2,200-lb. bomb load, and this, in turn, led to the G-series in which all the modifications made on the A-5/U3 were adopted as standard.

The Fw 190G actually preceded the Fw 190F specialised close-support fighter, and was intended to undertake both the fighter-bomber and fighter-dive-bomber roles. The pre-production Fw 190G-0 carried a 2,200-lb. bomb load and a gun armament of two 20-mm. MG 151 cannon, but the first quantity production model, the Fw 190G-1, had a specially strengthened undercarriage (later applied to the Fw 190F) which permitted a maximum bomb load of 3,970 lb. This could be carried in the form of a single 3,970-lb. bomb with cropped fins in order to provide the necessary ground clearance for take-off.

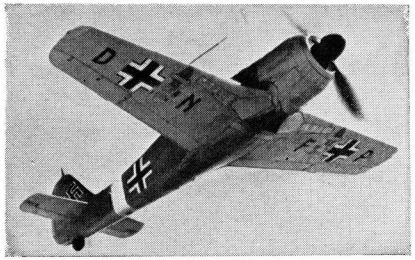
The Fw 190G-2, G-2/Trop, G-3 (two 7.9-mm. MG 17s and two 20-mm. MG 151s),

An early production Fw 190*G*-1 *which featured a specially strengthened undercarriage.*





Fw 190*F*-8



(*Above*) *An Fw* 190*G*-3 *with heavier armament.*

G-3/Trop, G-4, and G-4/Trop, were all powered by the BMW 801D-2 radial, and were similar apart from minor changes in equipment and bomb racks. The Fw 190G-7 was tested with a 198 Imp. gal. torpedo-shaped drop tank, and had a lengthened tailwheel yoke so that the tank cleared the ground during take-off, and the Fw 190G-8 had methanol-water (MW 50) power boost.

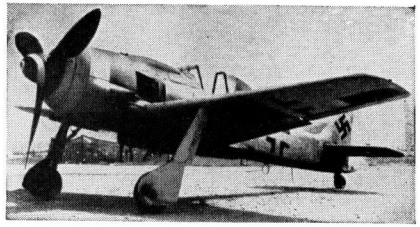
The Fw 190F was a specialised close-support fighter similarly powered to the G-series, featuring the strengthened under-carriage of the Fw 190G-1, and employing a new, clear-vision blown cockpit hood with suspended armour providing rear protection for the pilot's head as well as more extensive ventral armour for the engine and cockpit. The lower part of the engine cowling and the wheel covers were made of 6-mm. armour plate. In addition, 6-mm. plates were applied to the underside of the fuselage, the total weight of armour being of the order of 800 lb. The outer wing guns were omitted, and the pre-production Fw 190F-0 and production

F-1, F-2 and F-3 carried a built-in armament of two 7.9-mm. fuselage-mounted MG 17s and two 20-mm. MG 151 cannon in the wing roots. A typical bomb load comprised a single 550-lb. bomb under the fuselage and four 110-lb. bombs under the wings. The Fw 190F-3 had provision for carrying a single 66 Imp. gal. drop tank under each wing in place of the bombs, and the F-1 and F-2 had provision for a single tank of similar capacity under the fuselage. The suffix R1 applied to the Fw 190F-3 indicated the installation of simplified electrical bomb release gear. The Fw 190F-7 and F-7/Trop had 13-mm. MG 131s mounted in the fuselage in place of the MG 17s, but the most important production variant was the Fw 190F-8.

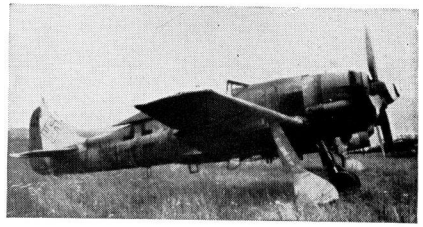
The Fw 190F-8 could carry a wide variety of ordnance loads, such as twenty-four R4M rockets, fourteen anti-tank rocket bombs, two clusters of three or two clusters of four rocket tubes under each wing, and various loads of anti-personnel bombs. The Fw 190F-8/R1 had more powerful bomb release gear; the F-8/R13 was a special night and bad-weather close-support fighter, with FuG 16Ze D/F and communications equipment, FuG 25a I.F.F., and other aids; the F-8/R14 had provision for carrying a torpedo and a lengthened tailwheel yoke; the F-8/R15 had a similar lengthened tailwheel yoke and carried a 3,086-lb. armour-piercing bomb, and the F-8/R16 could carry an ETC 501 or two BT 400 bombs. Several other sub-types were produced, including the Fw 190F-9 which normally carried six R4M rockets under each wing plus a single 550-lb. bomb, and the Fw 190F-16 with additional armour and modified radio equipment.

The following specification relates to the Fw 190F-3.

Type: *Single-seat Close-support Fighter.* **Power Plant:** *One* 1,700 *h.p. BMW* 801*D*-2 *fourteen-cylinder air-cooled radial engine.* **Armament:** *Two* 7.9-*mm. MG* 17 *machine guns and two* 20-*mm. MG* 151 *cannon plus* 1,100-*lb bomb load.* **Performance:** *Maximum speed,* 394 *m.p.h. at* 18,000 *ft.,* 342 *m.p.h. at sea level; initial climb rate,* 2,110 *ft./min.; service ceiling,* 34,780 *ft.; normal range,* 500 *mls.* **Weights:** *Empty,* 7,328 *lb.; normal loaded,* 9,700 *lb.; maximum* 10,850 *lb.* **Dimensions:** *Span,* 34 *ft.* 5½ *in.; length,* 29 *ft.* 0 *in.; height,* 13 *ft.* 0 *in.; wing area,* 196.98 *sq. ft.*



(*Above*) *An Fw* 190*F*-9 *with R4M rockets.*

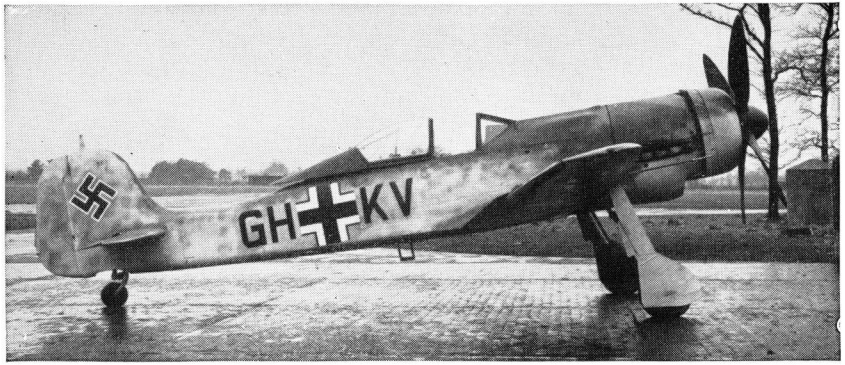


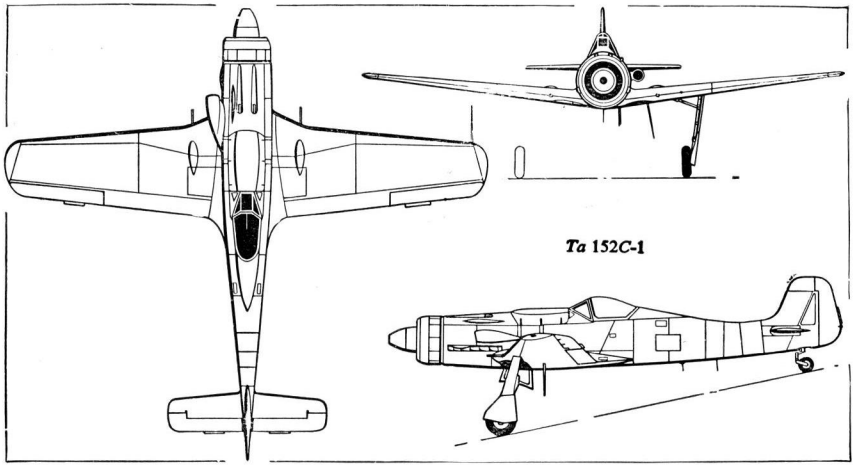
(*Above*) *An Fw* 190*F*-8, *the most important F-series model.*

The superb qualities of the Fw 190D fighter did not go unrecognised by the Reichsluftfahrtministerium, who rewarded Professor Dipl. Ing. Kurt Tank, primarily responsible for its design, by permitting him to employ the prefix "Ta" (indicating "Tank") in place of "Fw" (indicating "Focke-Wulf") for the designating of designs produced by his team. Tank took the opportunity provided by the incorporation of some modifications in the Fw 190D design to apply the designation Ta 152 to the modified fighter. Initially there were relatively few differences between the Fw 190D and the Ta 152. Structurally the two machines were similar, but the flap and undercarriage operating systems were changed from electric to hydraulic. The Junkers Jumo 213C engine was similar to the Fw 190D-9's Jumo 213A but made provision for a 30-mm. engine-mounted MK 108 cannon which augmented the twin 20-mm. MG 151s and the twin 13-mm. MG 131s.

A parallel development of the basic Fw 190 design was the Ta 153 high-altitude fighter. This differed appreciably from the Ta 152, embodying an extended, redesigned wing and a DB 603 engine, as well as numerous changes

An experimental development machine for the Ta 153.

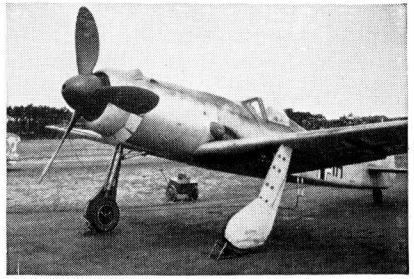




in the fuselage structure, tail assembly and systems. The various features of the Ta 153 were flight tested by several Fw 190 prototypes, but as the fighter called for many new jigs and tools whose provision would have seriously delayed production at a critical phase of the war, the R.L.M. instructed Tank to abandon the Ta 153 in favour of the Ta 152 which, in its original form at least, adhered much more closely to the basic Fw 190 design, and no true Ta 153 was flown.

The proposed initial production model, the Ta 152A, was flown in prototype form only, and the Ta 152B differed from the A-model principally in having a Jumo 213E-1 engine with an engine-mounted MK 108 cannon. Nitrous oxide (GM 1) was injected into the

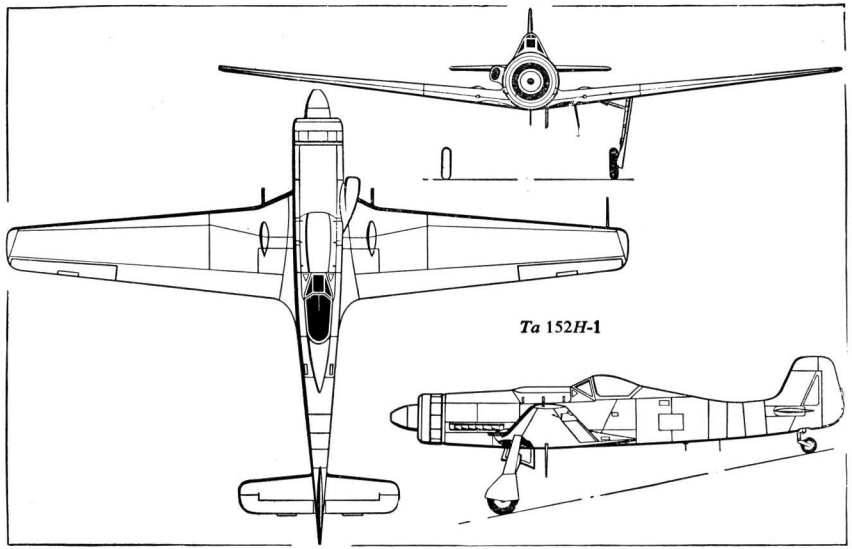
(*Below*) *An early Ta 152 prototype.*



(Above) A Ta 152C-0 and (left) a Ta 152 prototype.

Jumo 213E's supercharger, and the maximum speed of 439 m.p.h. at 35,000 ft. without using GM 1 was boosted to 443 m.p.h. at 44,300 ft. by this method of power boosting. Several production variants of the B-series were proposed, including the Ta 152B-5, which was to have carried a quartette of 30-mm. MK 103 cannon, but, like the A-series, the B-series was overtaken by the DB 603-powered Ta 152C which, classed as a medium-altitude fighter, was the first sub-type to be placed in production.

The Ta 152C differed from earlier models in having an elongated rear fuselage to compensate for the extra length of the DB 603 engine installation, enlarged vertical tail surfaces, and a modified wing structure which permitted an increase in internal fuel capacity from 165 Imp. gal. to 231 Imp. gal. Armament was standardised as four 20-mm. MG 151 cannon and one 30-mm. MK 108 cannon, and the pre-production Ta 152C-0 fighters received the DB 603E engine rated at 1,800 h.p. for take-off and offering a maximum speed of 417 m.p.h. at 27,000 ft., boosted to 448 m.p.h. at 32,800 ft. with the aid of GM 1. The first production model, the Ta 152C-1, received the DB 603LA with methanol-water (MW 50) power boost which raised take-off output to 2,300 h.p. The Ta 152C-3, in which an MK 103 cannon supplanted the MK 108, had the DB 603L which enjoyed the benefits of both GM 1 and MW 50. This variant could attain 463 m.p.h. at 34,400 ft.



Employing the airframe of the Ta 152C but powered by the Jumo 213E engine, the Ta 152E was a photo-reconnaissance model. This entered production in March 1945, and plans called for the delivery of 630 aircraft by the end of the year, but few were actually delivered, and the type did not become operational. The Ta 152E-1 carried a vertically-mounted RB 20/30, 50/30, or 75/30 camera aft of the cockpit (the E-1/R1 had an obliquely-mounted camera) and armament was restricted to two MG 151 cannon. Maximum speed was 428 m.p.h. at 35,000 ft., and range was 775 mls. at 385 m.p.h. at 29,500 ft.

Whereas the overall span of the Ta 152C had been increased to 36 ft. 1 in. (as compared with 34 ft. 5 in. for the A- and B-series), the Ta 152H high-altitude fighter featured a radically redesigned wing spanning no less than 47 ft. 6¾ in. The construction of the wing was unusual in that whereas the main spar extended outboard as far as the main undercarriage anchorage, the rear spar extended over the whole span, the necessary rigidity being

obtained by the use of close-set ribs and numerous lateral stringers reinforcing the stressed skin. A pressure cabin was installed, and a few pre-production Ta 152H-0 fighters powered by Jumo 213E engines were delivered for service testing, these carrying an armament of one 30-mm. MK 108 and two 20-mm. MG 151s. The Ta 152H-0 pre-production machines were largely rebuilt from Fw 190A-1 airframes. Production of the Ta 152H-1 began on November 21, 1944, but only ten were completed by the end of the war.

Several developments of the Ta 152H were contemplated, including the H-10 high-altitude photo-reconnaissance model with a single RB 20/30, 50/30, or 75/30 camera aft of the cockpit, and the Ta 152R-2, an experimental long-range version of the H-1 with increased fuel capacity. Projected developments included the tandem two-seat Ta 152S conversion trainer; a low-altitude fighter version powered by a Jumo 222A-3 engine rated at 3,000 h.p. for take-off, and a radial-engined sub-type which, with a four-stage supercharged BMW 801TR rated at 2,000 h.p. for take-off, had an estimated maximum speed of 442 m.p.h. at 38,400 ft.

The following specification relates to the Ta 152C-3, details in parentheses relating to the Ta 152H-1.

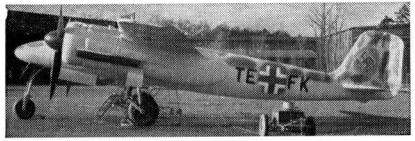
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 2,100 *h.p.* (1,880 *h.p. and* 2,250 *h.p. with MW* 50) *Daimler-Benz DB* 603*L* (*Junkers Jumo* 213*E*/*B*) *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *One* 30-*mm. MK* 103 (*MK* 108) *and four* (*two*) 20-*mm. MG* 151 *cannon.* **Performance:** *Maximum speed,* 339 *m.p.h. at sea level,* 359 *m.p.h. with MW* 50, 439 *m.p.h. at* 37,000 *ft.,* 463 *m.p.h. at* 34,000 *ft. with MW* 50 (431 *m.p.h. at* 35,000 *ft.,* 465 *m.p.h. at* 30,000 *ft. with MW* 50, 472 *m.p.h. at* 41,000 *ft. with GM* 1); *service ceiling,* 40,350 (48,560) *ft.*; *range,* (745 *mls.* at 372 *m.p.h. at* 32,800 *ft.*). **Weights:** *Empty,* 9,058 *lb.*; *normal loaded,* 11,025 (10,472) *lb.*; *maximum,* 12,125 (11,508) *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.* (47 *ft.* 6¾ *in.*); *length,* 35 *ft.* 5½ *in.*; *height,* 13 *ft.* 0 *in.*; *wing area,* 216 (252.95) *sq. ft.*

The third pre-production Ta 152*H, largely rebuilt from an Fw* 190*A*-1 *airframe.*

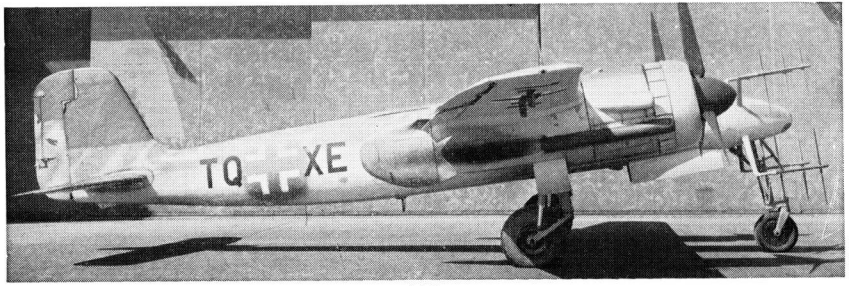
FOCKE-WULF TA 154A

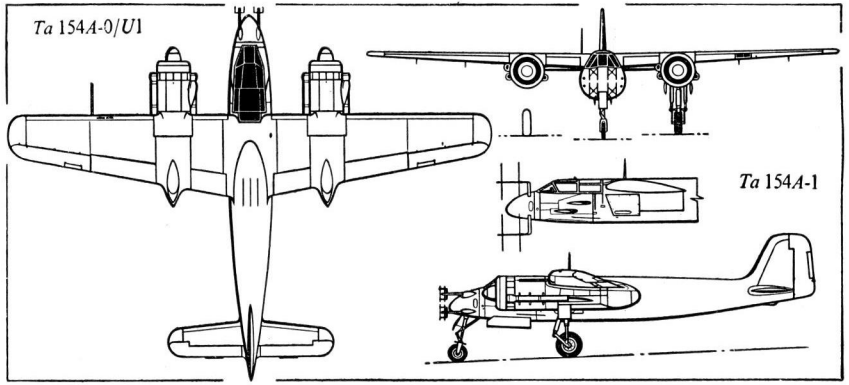
Known unofficially as the Moskito, the Ta 154 was designed to meet a requirement formulated in September 1942 for a specialised night fighter. The R.L.M. insisted on the extensive use of wood in the construction of the new machine, and stressed the need for rapid development. The first prototype, the Ta 154V1, was completed within ten months of the receipt of the development contract, flying for the first time on July 7, 1943, at Hanover-Langenhagen. Both the Ta 154V1 and the second prototype, the Ta 154V2, were powered by 1,500 h.p. Junkers Jumo 211 engines, but the Ta 154V3, which first flew on November 25, 1943, was powered by 1,776 h.p. Jumo 213A engines and carried an FuG 202 Lichtenstein BC-1 radar array. This prototype was followed by four additional prototype aircraft during the early months of the 1944, and these were tested with various types of radar installation.

Many wood-working firms were enlisted as sub-contractors in the Ta 154 production programme, and during the period June–August 1944, a batch of eight pre-production Ta 154A-0 aircraft was completed at Erfurt, these also being allocated *Versuchs* numbers (V8 to V15). After brief trials with a service



(*Above, right*) *The Ta* 154*V*1, (*right*) *the Ta* 154*V*7 *and* (*below*) *the Ta* 154*V*15.





test unit, these aircraft were withdrawn for further development work, six of them subsequently being modified for the *Mistel* role, warheads being installed in their forward fuselages and superstructures to carry Fw 190 director fighters being built on. Simultaneously work was progressing on the initial production model, the Ta 154A-1, the first two examples of which being built at Erfurt and subsequent aircraft being built at Posen, but on June 28, 1944, the second Ta 154A-1 disintegrated during high-speed runs. After the first Ta 154A-1 had also crashed, it was ascertained that the glue bonding the wood contained too much acid which weakened the joints. An initial batch of 250 Ta 154s had been ordered in November 1943, but the accidents resulted in their cancellation, and only a further seven Ta 154A-1s were completed. These were, however, delivered to a service unit. The Posen factory also built six examples of a modified version intended as a bomber destroyer. A warhead was installed in the nose, the cockpit moved further aft and a downward-firing ejector seat installed. Several advanced developments were projected at various times, including the Ta 154C and Ta 254, but none of these materialised. The specification relates to the Ta 154A-1.

Type: *Two-seat Night Fighter.* **Power Plant:** *Two* 1,750 *h.p. Junkers Jumo* 213*E twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Two* 30-*mm. MK* 108 *cannon with* 110 *r.p.g. and two* 20-*mm. MG* 151 *cannon with* 200 *r.p.g.* **Performance:** *Maximum speed,* 399 *m.p.h. at* 26,240 *ft.; range,* 855 *mls. at* 23,000 *ft., with two* 66 *Imp. gal. drop tanks,* 1,160 *mls.; time to* 26,240 *ft.,* 14.5 *min.; service ceiling,* 35,800 *ft.* **Weights:** *Loaded,* 19,842 *lb.* **Dimensions:** *Span,* 52 *ft.* 6 *in.; length,* 41 *ft.* 3 *in.; height,* 11 *ft.* 9¾ *in.; wing area,* 348.85 *sq. ft.*

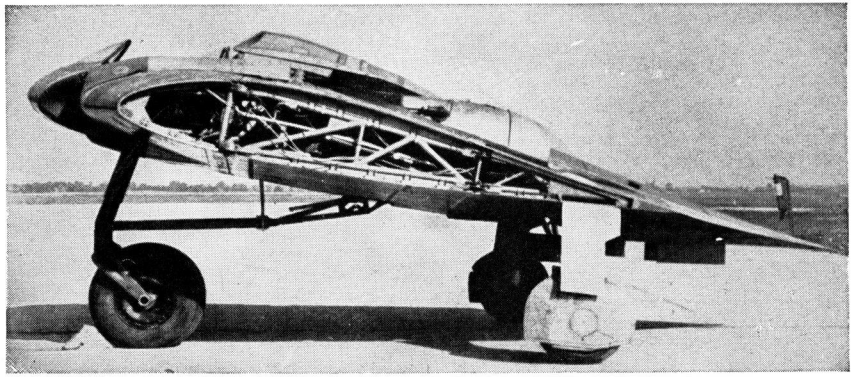
GOTHA GO 229 GERMANY

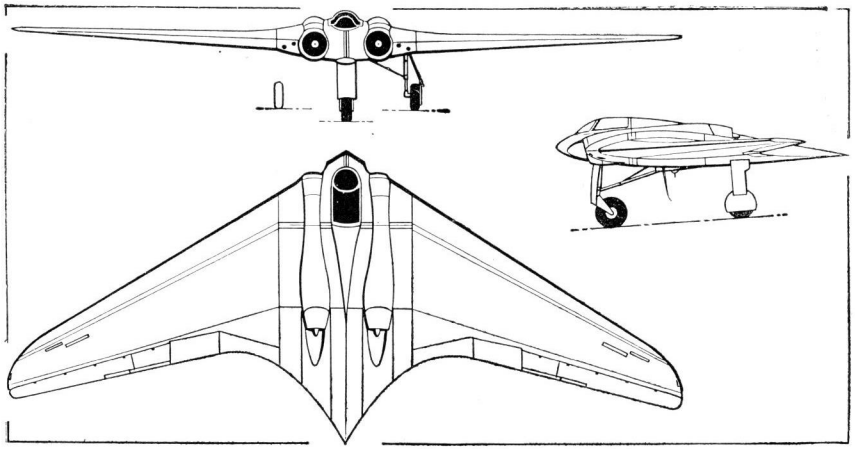
One of the many advanced fighter aircraft evolved by the German aircraft industry during the closing stages of World War II was the Gotha Go 229 designed by Reimar and Walter Horten and developed by the Gothaer Waggonfabrik. The Horten brothers belonged to a special Luftwaffe organisation known as Sonderkommando 9, and were allocated the task of developing all-wing aircraft. Work on an all-wing turbojet-driven fighter designated Ho IX began in 1942, the project envisaging the use of two BMW 003A-1 axial-flow turbojets housed in the swollen wing centre section which also accommodated the pilot, armament and fuel tanks.

Construction of the first two prototypes, the Ho IX V1 and Ho IX V2, was initiated at Gottingen, but as the diameter of the BMW turbojets proved greater than that foreseen, the first machine was completed as a glider with a fixed nosewheel, and flight tested at Oranienburg during the early summer of 1944. The Ho IX V2 was completed with a pair of 1,890 lb.s.t. Jumo 004B-1 turbojets and flew successfully with these, attaining speeds of the order of 500 m.p.h. After only two hours' flying, however, a fire started in one of the Jumo turbojets, and the aircraft was entirely destroyed after an attempted single-engined landing at Oranienburg.

In the meantime, the R.L.M. had instructed

(Right) The Ho IX V1 and (below) the Go 229*V*3.





the Gothaer Waggonfabrik to prepare for the quantity production of the all-wing fighter at their Friedrichsroda plant, allocating the official designation Go 229 to the machine. The company immediately began work on the construction of further prototypes and preparations for the production of twenty Go 229A-0 fighter-bombers for service evaluation. The first Gotha-built prototype was designated Go 229V3, and was powered by Jumo 004C turbojets with enlarged, redesigned air intakes. This aircraft was about to commence flight testing when the plant was occupied by American troops. At that time the Go 229V4 and V5, both of which were being built as two-seat night fighters, had reached an advanced stage of construction, and work on the V6 and V7 had commenced, the former being an armaments test aircraft and the latter being a two-seat trainer. The following specification relates to the Go 229A-0.

Type: *Single-seat Fighter-bomber.* **Power Plants:** *Two* 2,200 *lb.s.t. Junkers Jumo* 004*C axial-flow turbojets.* **Armament:** *Four* 30-*mm. MK* 103 *cannon and two* 2,200-*lb. SD* 1000, *or SC* 1000 *bombs.* **Performance:** *Maximum speed,* 590 *m.p.h. at sea level,* 640 *m.p.h. at* 21,000 *ft.; maximum cruising speed,* 559 *m.p.h.; initial climb rate,* 4,300 *ft./min.; service ceiling,* 51,000 *ft.; normal range,* 1,180 *mls.; maximum range (with one engine cut),* 2,485 *mls.* **Weights:** *Maximum loaded,* 18,700 *lb.* **Dimensions:** *Span,* 54 *ft.* 11¾ *in.; length,* 24 *ft.* 6 *in.; height,* 9 *ft.* 2¼ *in.; wing area,* 540.348 *sq. ft.*

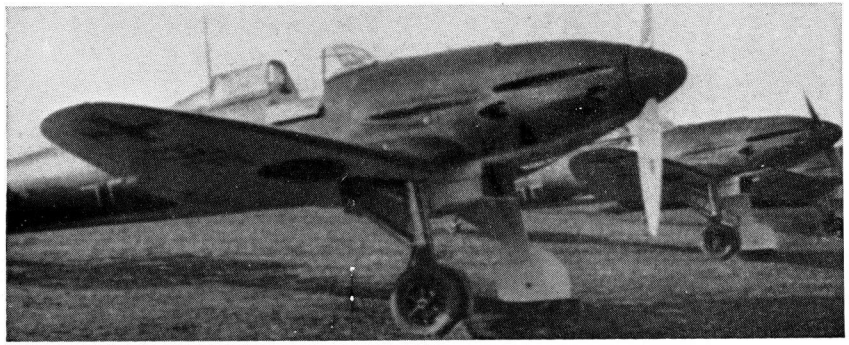
HEINKEL HE 112B

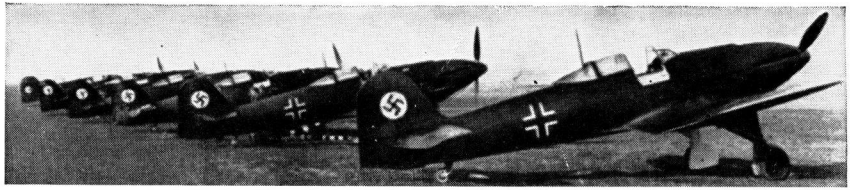
GERMANY

The Heinkel He 112 was originally designed to compete with the Messerschmitt Bf 109, and although never used operationally by the Luftwaffe was employed briefly by the Rumanian Air Force. The first prototype, the He 112V1 (D-IADO) powered by a 695 h.p. Rolls-Royce Kestrel V, appeared in the summer of 1935, and the He 112V2 differed in having a wing of reduced span (from 41 ft. 4 in. to 37 ft. 8¾ in.) and a 620 h.p. Junkers Jumo 210C engine. The He 112V3 (D-IDMO) was similar to the V2 (D-IHGE) apart from the installation of two 7.9-mm. MG 17 guns, and the He 112V4, (D-IZMY) powered by a 690 h.p. Jumo 210Da and carrying three MG 17 guns, was built as a production prototype for the proposed He 112A. Three additional A-series prototypes were built, the He 112V5, the He 112V6 (D-ISJY) with an enclosed all-round vision cockpit hood, and the He 112V8 (D-IRXO) which served as a test-bed for the 1,000 h.p. Daimler-Benz DB 600Aa engine, but the He 112V7 (D-IKIK) was the first B-series prototype which embodied a complete structural redesign and new wing and tail surfaces. The V7 was fitted with the DB 600Aa engine, but the true B-series production prototype, the He 112V9 (D-IGSI) which flew in the summer of 1937, had a 680 h.p. Jumo 210Ea engine.

The Luftwaffe received thirty He 112B-0 fighters for service evaluation, and these served briefly with a Jagdgruppe in 1938, seventeen of them subsequently being despatched to Spain where, flown by German volunteers, they operated with the Nationalist Group 5-G-5 during the Civil War, the fifteen survivors of this conflict continuing in service with the Spanish Air Force throughout the Second World War. Twelve of the remaining

The Luftwaffe briefly tested thirty He 112*B*-0 *fighters during* 1938.

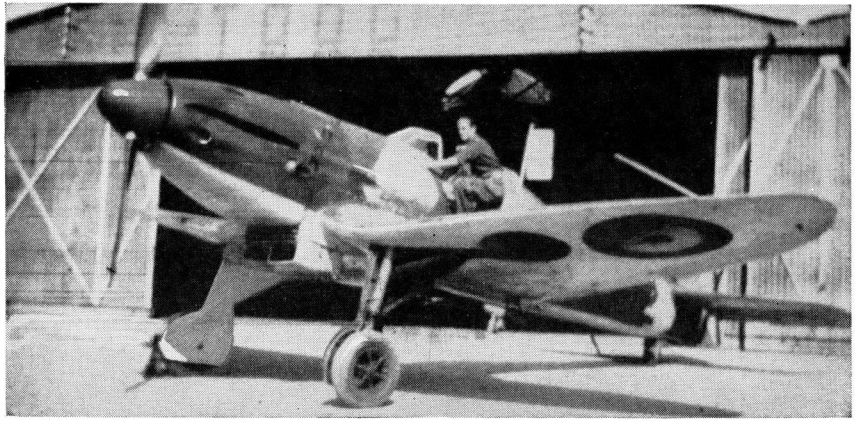


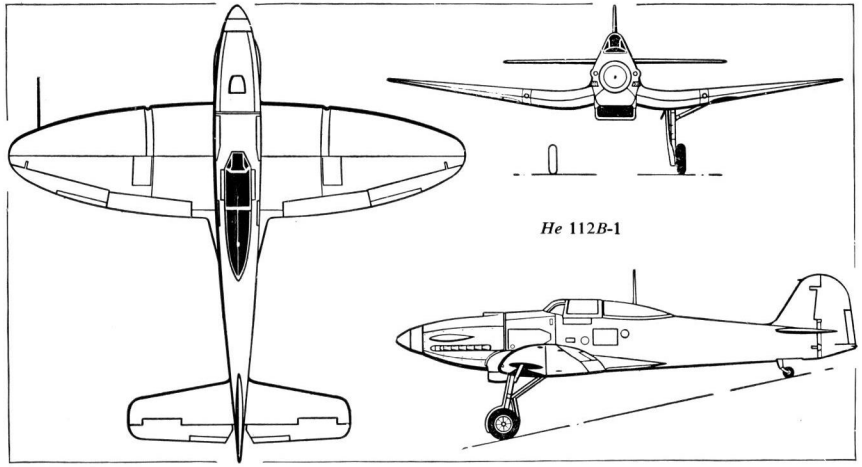


He 112B-0s were sold by the Luftwaffe to the Japanese Naval Air Service, being designated A7Hei. The J.N.A.S. planned to operate these from Hankow against Chinese Tupolev SB-2 bombers, but Japanese pilots, unused to the high wing loading of the He 112B, were disappointed by its manoeuvrability and climb rate, and the aircraft were relegated to the Tsuchiura Naval Air Station for use in training mechanics.

Twenty-four He 112B fighters were ordered for the Rumanian Air Force. The first thirteen of these were He 112B-0s and these were delivered to Rumania just before the Second World War commenced, and the remaining eleven machines were He 112B-1s which,

(Above) Luftwaffe He 112B-0s and (below) an He 112B-0 in service with the Spanish Air Force.





delivered during the last week of September 1939, differed from the He 112B-0s solely in having individual exhaust stubs for their Jumo 210Ea engines. Rumanian He 112Bs saw some action against Russian elements over the Bessarabian front during 1941.

The third and last B-series prototype was the He 112V11 (D-IYWE) powered by a 700 h.p. Jumo 210G engine. This preceded the He 112V10 (D-IQMA) which, powered by a 1,175 h.p. DB 601Aa engine, was intended as a prototype for the proposed He 112E series (the "E" suffix indicating "Export"). The He 112V10 attained a maximum speed of 354 m.p.h. at 12,140 ft., had an initial climb rate of 2,760 ft./min., a range of 715 mls. at 281 m.p.h., and a service ceiling of 31,170 ft. A second E-series prototype, the He 112V12 (D-IRXS), powered by a DB 600Aa engine was sold to Japan.

Type: *Single-seat Fighter-bomber.* **Power Plant:** *One* 680 *h.p. Junkers Jumo* 210*Ea twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. MG FF cannon and two* 7.9-*mm. MG* 17 *machine guns, and six* 22-*lb. anti-personnel bombs.* **Performance:** *Maximum speed,* 301 *m.p.h. at sea level and* 317 *m.p.h. at* 13,120 *ft.; normal range,* 683 *mls.; climb to* 19,685 *ft.,* 10 *min.; service ceiling,* 27,890 *ft.* **Weights:** *Empty,* 3,571 *lb.; loaded,* 4,960 *lb.* **Dimensions:** *Span,* 29 *ft.* 10¼ *in.; length,* 30 *ft.* 6 *in.; height,* 12 *ft.* 7½ *in.; wing area,* 182.986 *sq. ft.*

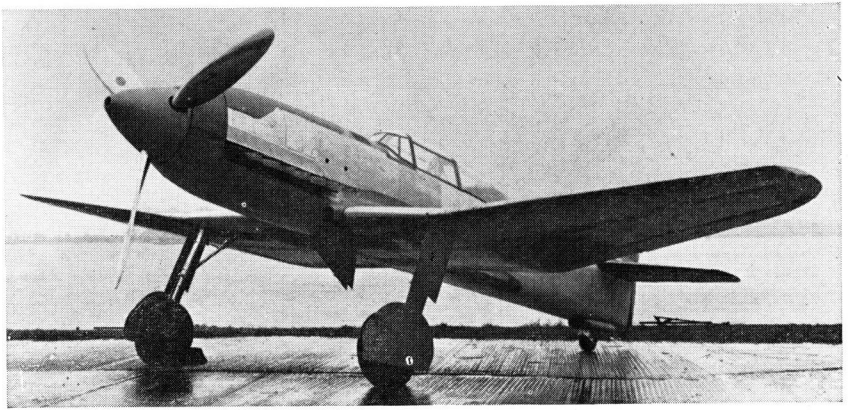
HEINKEL HE 100D

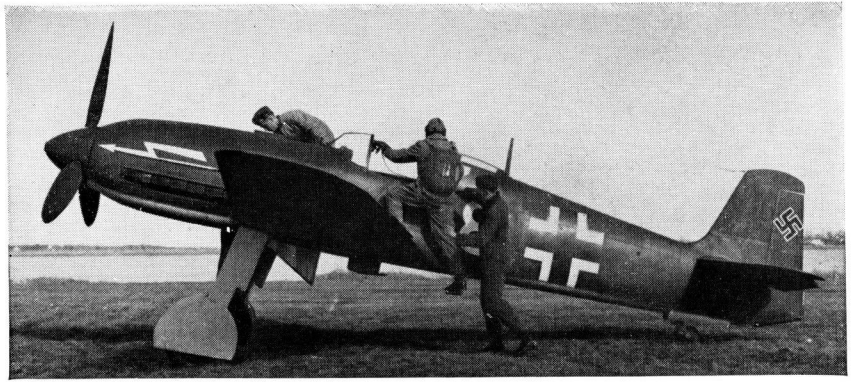
GERMANY

The Heinkel He 100D single-seat fighter was, for a considerable period of the war, an enigma. Allocated the designation "He 113" by the Reichsluftfahrtministerium and much publicised under this type number by the German Propaganda Ministry, the fighter never, in fact, bore this appellation as, presumably on the grounds of superstition, the designation had been changed to that of "He 100" while the aircraft was still under design. It was generally believed that the He 100 (alias He 113) had entered service with the Luftwaffe, but, the fighter was never accepted for service use. Only twelve production He 100D-1 fighters were built and, in a successful attempt to mislead Allied Intelligence, these were repainted with different insignia several times and many propaganda photographs of the fighter distributed, leading to the erroneous belief that the He 100 was in widespread use.

The first prototype, the He 100V1, was first flown on January 22, 1938, being rapidly followed by two further prototypes, the He 100V2 (D-IUOS) and V3 (D-IDGH), with redesigned vertical tail surfaces. On June 6, 1938, the He 100V3, flown by General Ernst Udet, captured the 100-km. closed-circuit record at 394.6 m.p.h. In an attempt to gain acclaim for the much-publicised He 112 fighter, at that time in limited production, the record-breaking aircraft was referred to as the "He 112U", although it bore no relationship to the He 112 fighter.

The Heinkel He 100V1 (below) featured a surface evaporation cooling system.

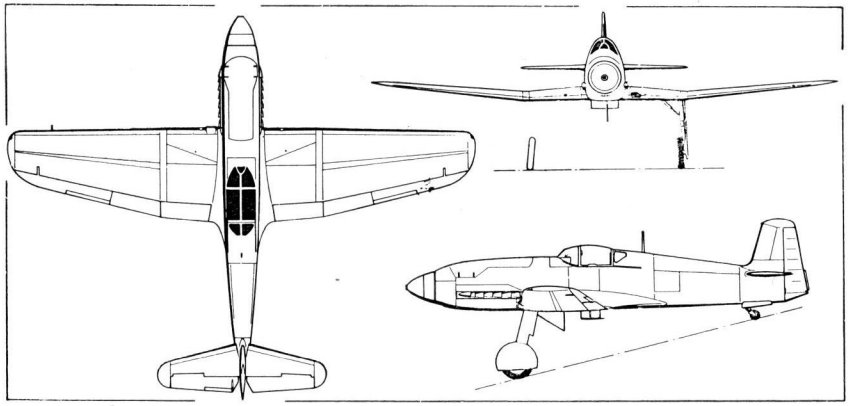




The He 100 had a wing span of only 26 ft. 10¾ in. and employed a system of surface evaporation cooling. Four further prototypes were built, the He 100V4, V5, V6, and V7, these embodying modifications dictated by the results of an investigation into the crash of the He 100V3 in September 1938, and incorporating service equipment. These were intended to serve as prototypes for the proposed He 100B fighter (the designation He 100A being applied to the *Versuchs* or experimental machines) and were intensively flight-tested by R.L.M. pilots at Rechlin-Mueritz. The Rechlin pilots were highly enthusiastic over the He 100's speed but deplored its extremely high wing loading and poor handling qualities.

The Ernst Heinkel A.G. therefore abandoned the He 100B and undertook an extensive redesign of the fighter in an attempt to improve its characteristics. The wing was redesigned and overall span increased to 30 ft. 10¾ in. to reduce the wing loading, and the surface evaporation cooling system which had proved impossible to perfect to a standard required for general service use, was supplanted by a semi-retractable belly radiator. This version was designated He 100D.

In the meantime, a further prototype had been constructed, the He 100V8, which was intended specifically for an attempt on the World Air Speed Record. Retaining the surface evaporation cooling system of the earlier *Versuchs* machines, the He 100V8 was fitted with a specially boosted version of the Daimler-Benz DB 601 engine which gave a maximum output of 1,800 h.p. for short periods. Flown by Hans Dieterle and again referred to as the "He 112U", the He 100V8 raised the Record to 463.92 m.p.h. on March 30, 1939. Encouraged by this success, the Ernst Heinkel A.G. began the construction of three He 100D-0 and twelve He 100D-1 fighters. How-



ever, despite the superior performance of the He 100D over the standard Bf 109E fighter, the official attitude was that the war would be won with the Messerschmitt and that production capacity could not be afforded for the quantity production of the Heinkel fighter.

Thus, six of the *Versuchs* machines (He 100V1, V2, V4, V5, V6 and V7) were sold to the Soviet Union, and the three pre-production He 100D-0 fighters were sold to Japan in October 1939, together with a manufacturing licence. The He 100D-0s reached Japan in May 1940, were assembled at Kasumigaura, and were delivered to the Japanese Naval Air Force under the designation AXHei. Plans were prepared to manufacture the AXHei as a standard J.N.A.F. land-based interceptor, the Hitachi Kokuki K.K. being allocated this task. The construction of a factory to build the AXHei was started at Chiba, but Heinkel's inability to supply jigs and tools prevented the plan reaching fruition.

The twelve He 100D-1 fighters were issued to a second-line squadron formed by Heinkel test pilots for the defence of the main Heinkel factory at Rostock-Marienehe.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,020 *h.p. Daimler-Benz DB* 601*M twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 7.9-*mm. MG* 17 *machine guns and one* 20-*mm. MG FF/M cannon.* **Performance:** *Maximum speed,* 416 *m.p.h. at* 13,120 *ft.; maximum cruising speed,* 345 *m.p.h.; initial climb rate,* 3,287 *ft./min.; service ceiling,* 32,450 *ft.; range,* 559 *mls.* **Weights:** *Empty,* 4,563 *lb.; loaded,* 5,512 *lb.* **Dimensions:** *Span* 30 *ft.* 10¾ *in.; length,* 26 *ft.* 10¼ *in.; height,* 8 *ft.* 2½ *in.; wing area,* 156.077 *sq. ft.*

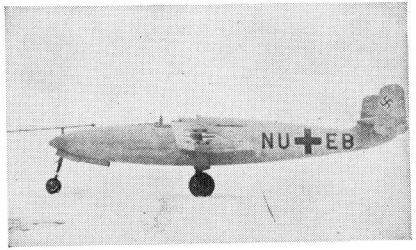
HEINKEL HE 280

GERMANY

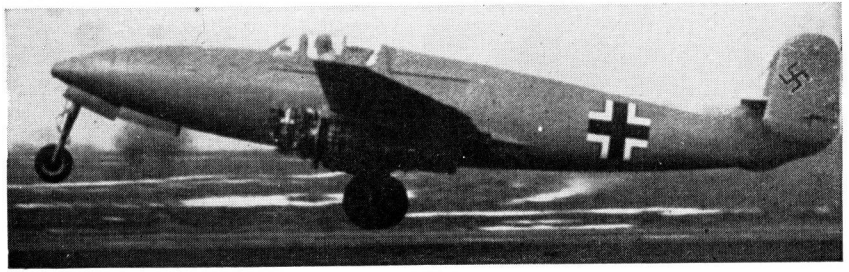
Possessing the distinction of being the world's first turbojet-driven fighter, the Heinkel He 280 was flown for the first time on April 2, 1941, by Fritz Schaefer. Development of the fighter had been initiated in 1939 under the direction of Heinkel's Technical Director, Robert Lusser, without the knowledge or approval of the Reichsluftfahrtministerium. By September 1940 the airframe of the first prototype, the He 280V1 (Werk-Nr. 280 000 001), was complete, and work had commenced on four additional prototypes. The He 280V1 was fitted with dummy turbojet nacelles and flown as a glider by Luftwaffe engineer-test pilot Bader, and forty-one gliding flights had been made by March 17, 1941, to test the prototype's handling characteristics prior to the installation of the engines.

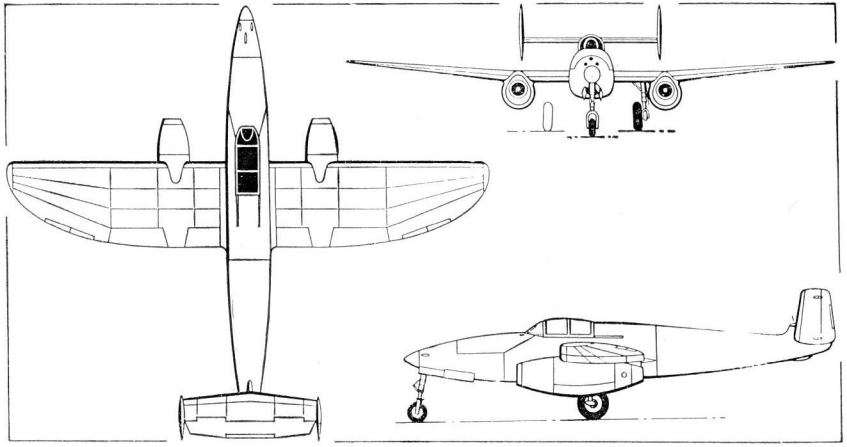
The He 280 was an extremely advanced design for, apart from being conceived specifically to use the revolutionary new turbojets, it employed a fully retractable nosewheel undercarriage which permitted the aircraft to taxi with its axis horizontal up to take-off and after touch-down, avoiding the problems that would undoubtedly have arisen had the thrust lines of the turbojets been directed towards the ground, and it featured a compressed-air ejection seat, the first of its kind developed anywhere in the world.

For the first flight of the He 280V1 on April 2, 1941, the Heinkel-Hirth HeS 8 turbojets of 1,320 lb.s.t. were left uncowled, as during ground running quantities of fuel tended to collect in the bottoms of the cowlings and



(Below) The He 280*V*1 *taking-off on its first flight. Nacelles later enclosed the turbojets. (Right) The He* 280*V*7 *with turbojets removed.*





thus presented a serious fire hazard. The aircraft climbed to 900 ft., made a circuit of the Rostock-Marienehe airfield with the undercarriage extended, and landed. Three days later, on April 5th, the He 280V1 made its second powered flight, this time with the turbojet cowlings fitted, before high-ranking officials, including Udet, Lucht, and Eisenlohr.

At the beginning of May, 1941 the He 280V2 was flown for the first time, but trouble was experienced with the HeS 8 turbojets, and the He 280V3, which joined the test programme in July, was fitted with the improved HeS 8A engines rated at 1,540 lb.s.t. In January 1942 the He 280V1 was transferred to Rechlin where six Argus As 014 impulse ducts were fitted under the wings as part of the development programme for the Fieseler Fi 103 missile. With these ducts fitted, the He 280V1 was incapable of taking-off without assistance, and the first attempted test flight was made on January 13, 1942, the aircraft being towed off the ground by two Messerschmitt Bf 110Cs. The He 280V1 started to ice-up shortly after take-off, and at 7,875 feet, the pilot, Schenk, was forced to evacuate the aircraft with the aid of his ejector seat, the pilot being totally unaware that he had gained the distinction of being the first person to make emergency use of an ejector seat in the history of aviation!

In June 1942 the HeS 8 turbojets of the He 280V2 were replaced by Junkers Jumo 004s, the first test flight with these engines being made during the following month, and in the same month armament was fitted for the first time, a trio of 20-mm. MG 151 cannon being

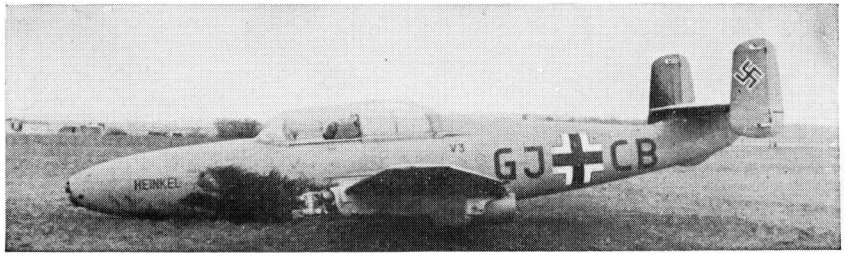
mounted in the nose of the He 280V2. The He 280V4 initially served as a testbed for the HeS 8A engines and was later fitted with BMW 003s, and the He 280V5 served as a BMW 003 testbed.

By the end of 1941 Ernst Heinkel considered the potentialities of the radical He 280 to be proven, and during the following year a Focke-Wulf Fw 190A fighter was flown to the nearby Arado factory at Warnemünde where it was pitted against the He 280 in mock combat. The He 280 proved its superiority over its adversary with ease, but despite its promise, the R.L.M. refused to sanction the quantity production of the He 280. Heinkel had decided to build three additional prototypes in September 1940, and the first of these, the He 280V6 powered by Jumo 004 turbojets, was used for armament trials at Rechlin in the summer of 1942, but at the end of that year further development of the design as a fighter was abandoned.

Construction of the remaining two prototypes continued, and the He 280V7 was flown for the first time on April 19, 1943, without turbojets and with a V-type or "butterfly" tailplane for comparison with orthodox tail assemblies. Two HeS 8A turbojets were later installed, and the He 280V7 flew with these for the first time in November 1943, testing continuing until February 1944 when, after the failure of one of the turbojets, the engines were removed and the aircraft again tested as a glider. The He 280V8, which flew for the first time on July 19, 1943, made ten powered flights, the last of these being effected on September 10, 1943, and was then converted to take a V-type tail similar to that of the V7, the engines being removed.

Type: *Single-seat Interceptor Fighter.* **Power Plants:** *Two* 1,540 *lb.s.t. Heinkel-Hirth HeS 8A* (109-001*A*) *turbojets.* **Armament:** *Three* 20-*mm. MG* 151 *cannon.* **Performance:** *Maximum speed,* 578 *m.p.h. at* 19,685 *ft.; initial climb rate,* 4,923 *ft./min.; service ceiling,* 49,200 *ft.; range,* 435 *mls.; endurance,* 46 *min.* **Weights:** *Empty,* 7,092 *lb.; loaded,* 9,413 *lb.* **Dimensions:** *Span,* 39 *ft.* 4⅛ *in.; length,* 33 *ft.* 5½ *in.; height,* 10 *ft.* 5⅞ *in.; wing area,* 231.5 *sq. ft.*

The He 280*V*3, *first flown in July* 1941, *seen after a forced landing resulting from a broken turbine blade. The He* 280*V*3 *was the first prototype to fly with the improved HeS* 8*A engines.*

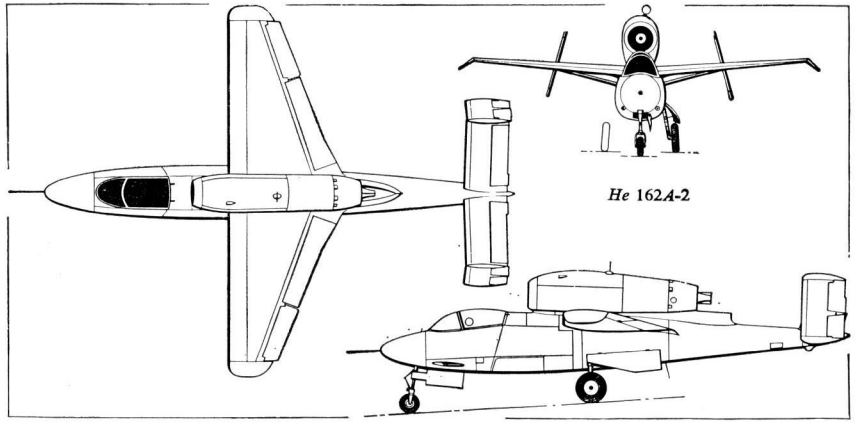


HEINKEL HE 162A SALAMANDER

GERMANY

Popularly known as the "Volksjäger" or People's Fighter, the Heinkel He 162 progressed from drawing board to initial flight tests in the fantastically short period of sixty-nine days! One of the most remarkable achievements of the German aircraft industry, the He 162 was the result of a specification issued by the Reichsluftfahrtministerium on September 8, 1944, which called for a high-performance fighter which, utilising a minimum of strategic materials and suitable for mass production by semi-skilled labour, would be ready for quantity production by January 1, 1945. To meet this requirement, the Heinkel company produced a design which, initially known as the He 162 Spatz (Sparrow), was inspected in mock-up form at Vienna-Schwechat on September 23, 1944, and five days later was awarded a quantity order, the projected output being 1,000 machines per month.

The first prototype, the He 162V1, flew for the first time on December 6, 1944, although defective bonding resulted in an undercarriage door breaking away during this initial test.



Four days later, Heinkel's chief test pilot, Flugkapitan Peter, demonstrated the aircraft in front of R.L.M., Luftwaffe and Nazi Party officials, but during a low-altitude, high-speed run, the starboard wing leading edge ripped away, followed by the starboard aileron and wingtip, and the prototype was totally destroyed. Nevertheless, development continued unabated, and the He 162V2 and V3 were rapidly completed, various modifications being incorporated during trials, such as the fitting of anhedral wingtips to reduce the effective dihedral angle, a weight over the nosewheel to bring the c.g. forward, changes to the wing root profile, and the design of a larger tail assembly.

The He 162 featured a one-piece wing of wooden construction, and the fuselage had duralumin formers and skin with a plywood nose, and the tail was of mixed duralumin, steel and wood. Three final assembly plants were planned: Heinkel-Nord at Rostock with a monthly capacity of 1,000 machines, the Junkers plant at Dessau with a similar monthly capacity, and the Mittelwerke G.m.b.H. with a monthly capacity of 2,000 machines. Heinkel's plant at Vienna-Schwechat was responsible for development and the pre-production batch of He 162A-0 fighters. Many other plants were integrated in the production progamme, and initial production machines were delivered in February and March 1945 to training units at Ludwigslust and Rechlin, and to the first operational unit to re-equip with this fighter, J.G.84 based at Leck in Schleswig-Holstein. The initial production He 162A-1 and A-2 differed only in equipment, and carried an armament of two 20-mm. MG 151 cannon with 120 r.p.g., but the He 162A-3

A standard production He 162A-2 fighter with twin MG 151 cannon armament.

had two 30-mm. MK 108 cannon with 50 r.p.g. The production machines were variously powered by the BMW 003A-1 or A-2, or the BMW 003E-1 or E-2, all of which units were rated at 1,760 lb.s.t.

Only 116 pre-production and production He 162A Salamander fighters were actually completed, although appreciable numbers had reached an advanced stage of assembly at the time of Germany's defeat. Numerous variants of the He 162 with alternative power plants were being considered, including the BMW 003R combined turbojet and rocket, with which a maximum speed of 628 m.p.h. at sea level was anticipated, the Jumo 004D and E, and a pair of 780 lb. thrust Argus As 014 impulse ducts or one 1,100 lb. thrust As 044 impulse duct. The definitive version of the design was to have been powered by a 2,860 lb.s.t. HeS 11 turbojet and feature a V-type tail assembly similar to that tested by the He 280. Both swept-back and swept-forward wings were considered for this model, and the Allies captured a half-completed prototype for the HeS 11-powered model for which interchangeable swept-back and swept-forward wings had been built. It was anticipated that mass-production of the HeS 11-powered He 162 would commence in 1946.

Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,760 *lb.s.t. BMW* 003*A*-1, -2, *or E*-1, *E*-2 *axial-flow turbojet.* **Armament:** *Two* 30-*mm. MK* 108 *cannon with* 50 *r.p.g.* **Performance:** *Maximum speed,* 490 *m.p.h. at sea level,* 522 *m.p.h. at* 19,700 *ft.,* 485 *m.p.h. at* 36,000 *ft.; initial climb rate,* 4,230 *ft./min.; time to* 19,700 *ft.,* 6.6 *min., to* 36,000 *ft.,* 20 *min.; ceiling,* 39,500 *ft.; endurance, full throttle at sea level,* 20 *min., at* 36,000 *ft.,* 57 *min.; range,* 410 *mls. at* 36,000 *ft.* **Weights:** *Normal loaded,* 5,480 *lb.; maximum loaded,* 5,940 *lb.* **Dimensions:** *Span,* 23 *ft.* 7¾ *in.; length,* 29 *ft.* 8½ *in.; wing area,* 120 *sq. ft.*

HEINKEL HE 219 UHU

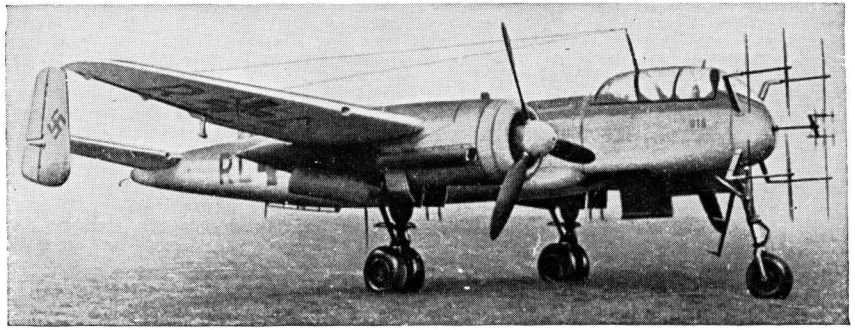
GERMANY

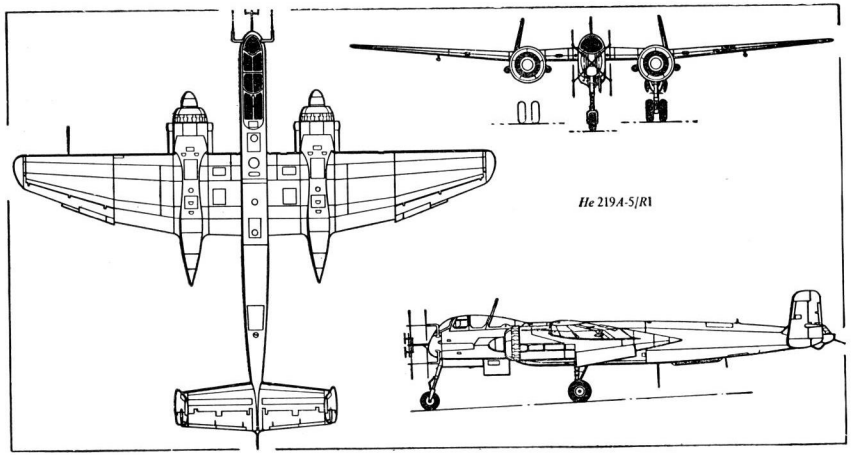
In August 1940 the project office of the Ernst Heinkel A.G. submitted proposals to the R.L.M. for a twin-engined high-speed aircraft in the Zerstörer class readily adaptable from the fighter configuration for short- and medium-range bombing and torpedo-dropping. These proposals did not immediately find favour, but when, late in 1941, R.A.F. night attacks on Germany began to assume increasingly serious proportions, Heinkel was requested to develop the design as a specialised night fighter. Detailed design commenced at Rostock in January 1942, prototype construction starting simultaneously, but during March and April all completed drawings were destroyed during two R.A.F attacks, necessitating the transfer of the development office to Vienna-Schwechat.

Despite the resulting delays, the first prototype, designated He 219V1 and later to be dubbed the Uhu (Owl), flew on November 15, 1942, powered by two 1,750 h.p. DB 603A engines. The prototype evinced remarkably fine qualities from the outset, and during the following month it was flown to Peenemünde for armament trials, two 20-mm. MG 151 cannon being mounted in a tray beneath the fuselage and one movable 13-mm. MG 131 being mounted in the rear cockpit. In February 1943 the twin MG 151s were supplanted in the ventral tray by a quartette of 30-mm. MK 108s, and in March three additional prototypes had joined the test programme, the first of these, the He 219V2, having flown in December 1942 with a forward-firing armament of six MG 151s, two of these being mounted in the wing roots. The V3 carried a similar armament but featured enlarged vertical tail surfaces, and the V4 was the first machine to carry airborne radar (FuG 202).

By April 1943, factories at Milec and Buczin in Poland, and at Rostock and Vienna-

The He 219V16 (below) was initially modified as an He 219A-0/R6 and subsequently as an A-5/R2.





Schwechat were producing components for the He 219, and the order for one hundred He 219A-0s placed prior to flight trials, in August 1942, had been trebled. A further six prototypes (He 219V5 to V10 inclusive) had been delivered or were nearing completion, and several of these were transferred as He 219A-0s to a night fighter unit based at Venloe in Holland for trials under operational conditions. With a forward-firing armament of four MK 108s and two MG 151s the designation He 219A-0/R1 was applied to these trials aircraft, but with four MK 103s of similar calibre in place of the MK 108s they were designated He 219A-0/R2. On the night of June 11–12, 1943, one of the Luftwaffe's leading night fighter pilots, Major Streib, flying an He 219A-0/R2 from Venloe destroyed five R.A.F. bombers in one sortie, and during the first six sorties by He 219s from this base the destruction of no less than twenty R.A.F. bombers, including six Mosquitos, was claimed!

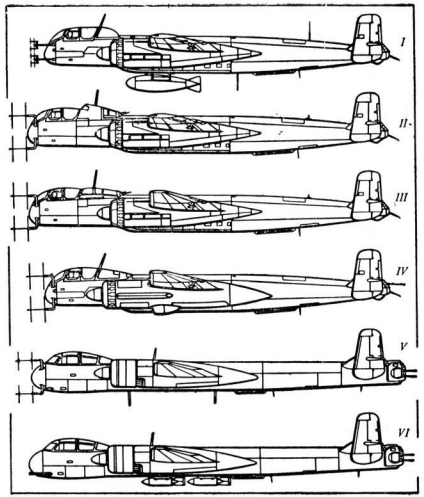
In July 1943 the first batch of pre-production He 219A-0/R3 fighters left the assembly line at Schwechat, these carrying four 20-mm. MG 151 cannon in their ventral trays owing to a shortage of the larger calibre MK 103s and MK 108s. The He 219V11 (A-0/R6) featured two 30-mm. MK 108s firing obliquely upwards in a so-called "Schräge Musik" installation, and the V12 switched to 1,800 h.p. DB 603E engines, and there were no less than eighteen additional *Versuchs* (Experimental) machines with DB 603A, Aa, E or G engines and converted from pre-production or

production He 219As to test various equipment installations and armament combinations.

The proposed He 219A-1 production model, for which the He 219V11 served as a prototype, was not proceeded with, and when, in August 1943, full production commenced at Rostock, the initial model was the He 219A-2/R1 for which the V12, V14, and V19 served as production prototypes. Powered by two DB 603A engines, the He 219A-2/R1 was supposed to receive two MK 108 cannon in its ventral tray, but the forty aircraft of this type delivered had a pair of MG 151s in this position with two additional MG 151s in the wing roots and two MK 108s in a "Schräge Musik" installation.

By July 1943 the R.L.M. had been demanding the delivery of twenty-four He 219s per month, but owing to the shortage of skilled workers, Heinkel could not promise a delivery rate of more than ten per month before December, with the completion of the 300-machine pre-production order by mid-1944. The He 219A-3 was a projected three-seat high-speed bomber powered by 1,900 h.p. DB 603G engines and carrying four 550-lb. bombs, and the He 219A-4 was a high-altitude reconnaissance-bomber powered by Junkers Jumo 222A/B engines and having a wing span of 86 ft. 11½ in. as compared with the normal span of 60 ft. 8½ in. This stemmed from the Hütter Hü 211 in which an He 219A fuselage was married to a new long-span wooden wing, and two He 219A-4s were under construction in 1944 but destroyed prior to completion.

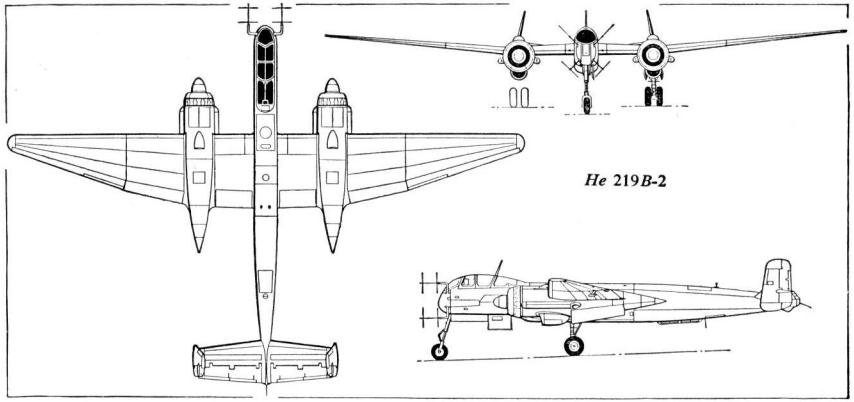
The next production model was the He 219A-5/R1 which differed from the A-2/R1 principally in having an 86 Imp. gal. fuel tank in the rear of each engine nacelle which increased range by some 400 miles. The He 219A-5/R2, for which the converted He 219V16 and the V20 served as prototypes, differed in being powered by 1,800 h.p. DB 603E engines;



Above: (I) He 219A-2/R1; (II) He 219A-5/R4; (III) He 219B-1; (IV) He 219B-3; (V) He 219C-1; (VI) He 219C-2.

the A-5/R2-U2 (the prototype of which was the He 219V22) had 1,900 h.p. DB 603G engines, and the A-5/R3 had 1,800 h.p. DB 603Aa's.

The He 219A-5/R4, for which the He 219V30 served as production prototype, carried an additional crew member in a stepped cockpit which resulted in a substantial increment of drag and a consequent reduction in performance. Nevertheless, a number of He 219A-5/R4 fighters were hastily placed in service while a new cockpit of reduced drag



was being designed. This model was powered by DB 603E engines and carried a movable 13-mm. MG 131 in the rear cockpit. The new long-span wing later employed by the He 219B was intended for this model but was not ready in time.

In May 1944 Erhard Milch issued instructions to terminate He 219 production in favour of the Ta 154 and Ju 388J. The order was tacitly ignored, however, Luftwaffe units constantly demanding increased deliveries of the fighter. In fact, one Luftwaffe maintenance unit succeeded in assembling six He 219s from its stock of components, these being unique as they bore no Werk-Nrs., and their existence was carefully withheld from the R.L.M.

In August 1944 the He 219A-6 entered service for use against R.A.F. Mosquitos. Fitted with DB 603L engines rated at 1,750 h.p. each, the He 219A-6s were converted from A-2/R1 aircraft, their "Schräge Musik" installation being removed together with all armour protection in order to improve altitude performance, but the last major production model was the He 219A-7 which differed from the A-2 and A-5 externally in having larger intakes of improved form for the superchargers. The He 219V11 was converted to serve as the first A-7 prototype, others being the V25, V26 and V27. Powered by 1,900 h.p. DB 603Gs, all He 219A-7s had two 30-mm. MK 108s in a "Schräge Musik" installation, but forward-firing armament varied. The He 219A-7/R1 and R2 had two 30-mm. MK 108s in the wing roots, the former having two MG 151s and two MK 103s in the ventral tray, and the latter having two MG 151s and two MK 108s in this position; the He 219A-7/R3 had MG 151s in the wing roots and a similar belly tray armament to the R2, and the R4 had two

MG 151s in both the wing roots and the tray, and was the first variant to be equipped with tail warning radar. The He 219A-7/R5 had Junkers Jumo 213E engines with methanol-water injection, and the A-7/R6 was the only model to be fitted with 2,500 h.p. Jumo 222A/B engines which boosted maximum speed and climb rate to 435 m.p.h. and 1,850 ft./min. Six A-7/R5 aircraft were completed for anti-Mosquito duties and one A-7/R6 was completed and flown.

In November 1944 the "Emergency Fighter Programme" was announced, but although the He 219 was not included in this programme, production continued until the factories producing this fighter were overrun by Russian troops. Only 268 genuine production He 219s had been produced, and of these 195 had been delivered in 1944 and 62 in 1945. In addition, 20 prototypes were pressed into service with Luftwaffe units.

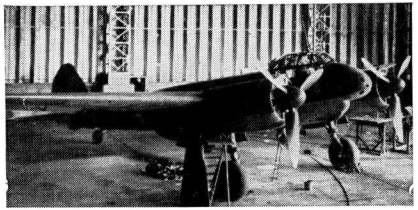
While production of the A-series had been slowly gaining momentum, several improved variants of the Uhu had been proposed. The first of these, the He 219B-1, was a three-seat fighter with a span and length of 72 ft. 4½ in. and 53 ft. 7¼ in. respectively. Although intended to receive Jumo 222A/B-3 engines, the sole example built had DB 603Aa engines and enjoyed an extremely brief life, the starboard undercarriage leg collapsing during its second landing, resulting in extensive damage. The He 219B-2 stemmed from the stripped A-6 and was also intended for anti-Mosquito duties. The few B-2s completed and hurriedly placed in service were two-seaters powered by DB 603Ls, and their armament, comprising two forward-firing MG 151s, was found to be inadequate. The He 219 B-3 reverted to the forward-firing armament of four MG 151s and two MK 108s with two additional MK 108s in a "Schräge Musik" installation. This version also received the DB 603L although it was intended to supplant this power plant with the Jumo 222 if and when supplies of this more powerful engine improved.

In May 1944 Heinkel had started work on two variants of an extensively modified version of the basic Uhu, the He 219C. The He 219C-1 and C-2 were respectively night fighter and fighter-bomber variants which were externally similar apart from the FuG 220 radar array of the former. The wing was similar to that of the B-series, but the fuselage was extensively redesigned and a crew of four was carried, one crew member being accommodated in a pressurised Rheinmetall-Borsig tail turret armed with four 13-mm. MG 131 machine guns. Power was to have been provided by two 2,500 h.p. Jumo 222A/B-3 engines, and the C-2 was to have carried three 1,100-lb. bombs under the fuselage. Prototypes of each version were awaiting the delivery of engines at the time of the collapse.

The accompanying specification relates to the He 219A-7/R1 which was representative of all late production A-series aircraft.

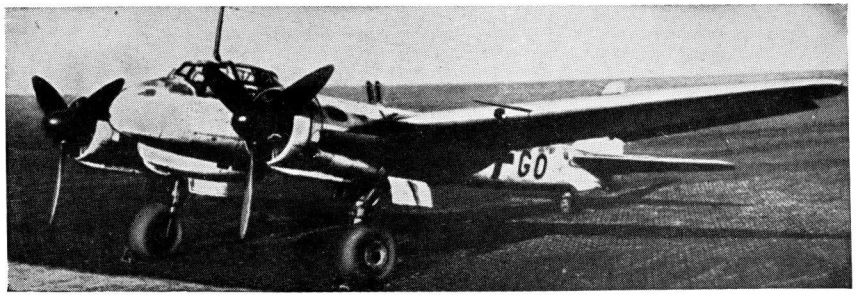
Type: *Two-seat High-altitude Night Fighter.* **Power Plants:** *Two* 1,900 *h.p. Daimler-Benz DB* 603*G twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Two* 30-*mm. MK* 108 *cannon in wing roots, two* 30-*mm. MK* 103 *cannon and two* 20-*mm. MG* 151 *cannon in ventral tray, and two* 30-*mm. MK* 108 *cannon firing obliquely upwards.* **Performance:** *Maximum speed,* 416 *m.p.h. at* 22,965 *ft.; normal cruising speed,* 335 *m.p.h.; maximum cruising speed,* 391 *m.p.h.; range, at maximum continuous cruising speed,* 960 *mls., at economical cruising speed,* 1,243 *mls.; initial climb rate,* 1,810 *ft./min.; maximum ceiling,* 41,660 *ft.* **Weights:** *Empty,* 24,692 *lb.; loaded,* 33,730 *lb.* **Dimensions:** *Span,* 60 *ft.* 8½ *in.; length,* 50 *ft.* 11¾ *in.; height,* 13 *ft.* 5½ *in.; wing area,* 478.994 *sq. ft.*

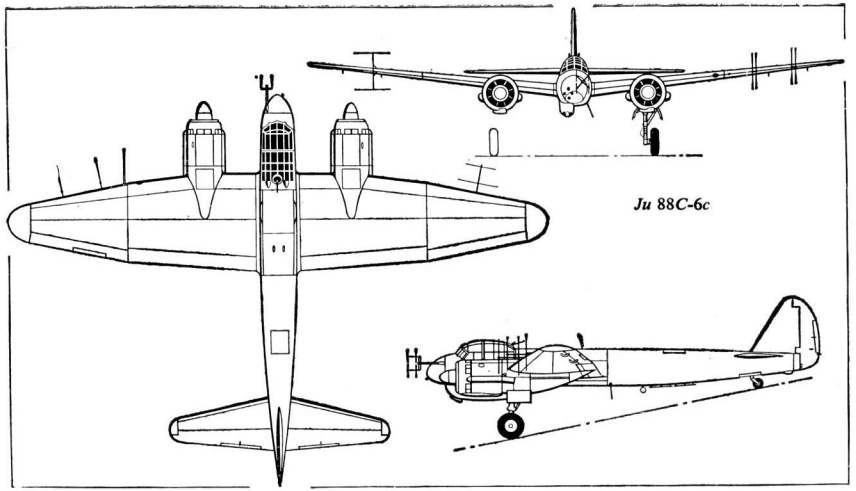
The outstanding performance of the Junkers Ju 88 evinced during its earliest prototype trials led to interest in the possibility of its adaptation for roles other than that of high-speed bomber for which it had been conceived, and an obvious task for this exceptional warplane was that of *Zerstörer*, or heavy fighter. In fact, on September 27, 1938, twenty-one months after the Ju 88's first flight and before the first pre-production Ju 88A-0 bombers had left the assembly line, the flight testing of a fighter prototype, the Ju 88V7, commenced. Powered by Junkers Jumo 211B-1 liquid-cooled engines each rated at 1,200 h.p., the Ju 88V7 carried a forward-firing armament of two 20-mm. MG FF cannon and two 7.9-mm. MG 17 machine guns in a "solid" nose. This prototype was destined to become the forerunner of one of the most important warplanes in Germany's air arsenal during the early 'forties, the Ju 88C.



Although no thought had been given to the adaptation of the Ju 88 as a night fighter, the appearance of R.A.F. bombers at night over Germany resulted in a proposal for an interim night fighter model, the Ju 88C-1, powered by BMW 801A engines. This was abandoned in favour of a straight-forward conversion of the Ju 88A-1 powered by Jumo 211B-1 engines and designated Ju 88C-2. A single 20-mm. MG FF cannon and three 7.9-mm. MG 17 machine guns were mounted ahead of an 11-mm. circular armoured bulkhead, one 7.9-mm. MG 15 was operated by the observer,

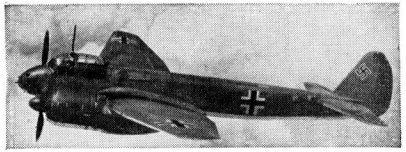
(Above, left) A Ju 88C-6 day fighter and (below) a 1944 production Ju 88C-6 with "Shräge Musik".





and a 1,100-lb. bomb load could be carried internally. The first twenty Ju 88C-2 conversions were delivered to the second Gruppe of Nachtjagdgeschwader 1 before the end of 1940, sixty-two Ju 88A-1 airframes being converted to C-2 configuration in that year, and these enjoyed some success against R.A.F. bombers passing through coastal searchlight belts.

The Ju 88C-3 was an experimental BMW 801A-powered model, and the Ju 88C-4 was the first model built from the ground up as a heavy fighter. Similarly powered to the Ju 88C-2, the C-4 employed an airframe generally similar to that of the Ju 88A-4 bomber, and overall wing span was increased from 59 ft. 10¾ in. to 65 ft. 10½ in. Relatively few Ju 88C-4 fighters were produced as production priority was still being given to bomber variants of the design, sixty-six Ju 88C fighters leaving the assembly lines in 1941. The Ju 88C-5 was limited to a pre-production batch of some dozen machines, these having BMW 801D radial engines, but with increasing demand for Ju 88 fighters and the need to expand the so-called "Kammhuber Line" of night fighter boxes, large-scale production was initiated, 257 machines being delivered in 1942. During this year, the Ju 88C-6 was introduced onto the assembly lines, this being powered by Jumo 211J engines and carrying a forward-



(*Above and below*) *The Ju 88R-1 heavy day fighter.*

firing armament of three 20-mm. MG FF cannon and three 7.9-mm. MG 17 machine guns in the nose. In addition, a rear-firing 13-mm. MG 131 was carried. On some Ju 88C-6s a pair of 20-mm. MG 151 cannon were arranged to fire obliquely upward.

While the Ju 88C-6a was primarily a day fighter, the Ju 88C-6b was a night fighter retroactively fitted with FuG 212 (Lichtenstein) radar. This radar had been fitted early in 1942 to four of NJG 1's Ju 88C fighters, and as the cumbersome aerial array reduced maximum speed by some 25 m.p.h., the reactions of the crews were unfavourable until a number of positive successes were gained with the aid of FuG 212. A lighter aerial array reduced its detrimental effect on the performance of the Ju 88C-6b, but the first use of "window" jamming by the R.A.F. rendered FuG 212 useless and, in October 1943, the Ju 88C-6c appeared operationally with FuG 220 radar which operated on another frequency.

The final production model of the Ju 88C was the Ju 88C-7 heavy fighter and intruder with a jettisonable belly gun pack. The C-7a had provision for a 1,100-lb. internal bomb load, and the C-7b had underwing bomb racks, increasing the maximum permissible bomb load to 3,300 lb. Whereas the Ju 88C-7a and b were powered by the Jumo 211J, the Ju 88C-7c was powered by BMW 801A radials. The last-mentioned model was purely a heavy fighter with no bomb racks. Its forward-firing armament comprised three MG 17s, two MG FF, and one MG 151, and only a pre-production batch was completed.

The Ju 88R-1 was essentially similar to the Ju 88C-7c, being a heavy day fighter with similar BMW 801A engines and forward-firing armament, and the Ju 88R-2 was a night fighter variant with 1,700 h.p. BMW 801D radials and FuG 220 radar equipment.

During 1943 production of Ju 88C and R fighters rose to 706 aircraft, and in the following year, when these models were phased out of production in favour of the newer Ju 88G-0, no fewer than 2,518 Ju 88 fighters were delivered. The following specification relates specifically to the Ju 88C-6c.

Type: *Three-seat Night Fighter.* **Power Plants:** *Two* 1,410 *h.p. Junkers Jumo* 211*J twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Three* 20-*mm. MG FF cannon and three* 7.9-*mm. MG* 17 *machine guns firing forward, one rearward-firing* 13-*mm. MG* 131 *machine gun, and* (*optional*) *two* 20-*mm. MG* 151 *cannon firing obliquely upward.* **Performance:** *Maximum speed,* 311 *m.p.h. at* 19,685 *ft.; maximum cruising speed,* 280 *m.p.h.; normal cruising speed,* 264 *m.p.h.; initial climb rate,* 1,770 *ft./min.; maximum ceiling,* 32,480 *ft.; maximum range* (*with external fuel*), 2,131 *mls.* **Weights:** *Empty,* 18,871 *lb.; normal loaded,* 26,125 *lb.* **Dimensions:** *Span,* 65 *ft.* 10½ *in.; length,* 47 *ft.* 1⅓ *in.; height,* 16 *ft.* 7½ *in.; wing area,* 590 *sq. ft.*

JUNKERS JU 88G

GERMANY

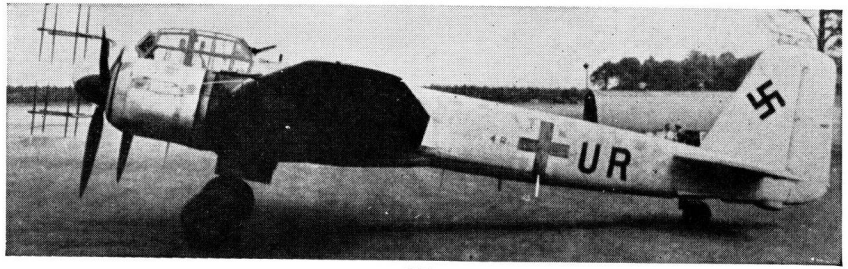
By midsummer 1944, when the Ju 88G-1 first appeared in action, the night fighter force had become the strongest and most efficient arm of the Luftwaffe, and comprised no less than fifteen per cent of first line strength. The Nachtjagdgeschwader were largely equipped with variants of the Ju 88C, but the constant increase in the importance of night defence necessitated the development of a specialised night fighting model, the Ju 88G. FuG 220 (Lichtenstein SN-2) radar had been installed experimentally in a Ju 88C-5 which, redesignated Ju 88GV1, served as a prototype for the G-series of night fighters. FuG 220 was later installed in the Ju 88C-6c pending the availability of the improved Ju 88G-1.

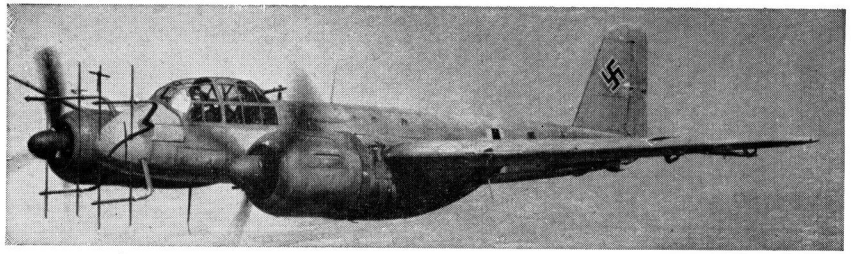
The pre-production Ju 88G-0 differed from all earlier fighter versions of the basic design in having the more angular vertical tail surfaces of the Ju 188 bomber, and forward-firing armament comprised six 20-mm. MG 151 cannon, although this was reduced to four cannon in the initial production Ju 88G-1 which, like the G-0, was powered by a pair of 1,700-h.p. BMW 801D radials.

The Ju 88G-2 to G-5 were experimental models with equipment changes, and did not attain production, and the next variant to be manufactured in quantity was the Ju 88G-6. The Ju 88G-6a, which was similar to the G-1 apart from having 1,700 h.p. BMW 801G radials, and the G-6b had additional radio equipment and two 20-mm. MG 151 cannon firing obliquely upwards in a "Shräge Musik" installation. A variant powered by 1,750 h.p. Jumo 213A liquid-cooled engines was designated Ju 88C-6c.

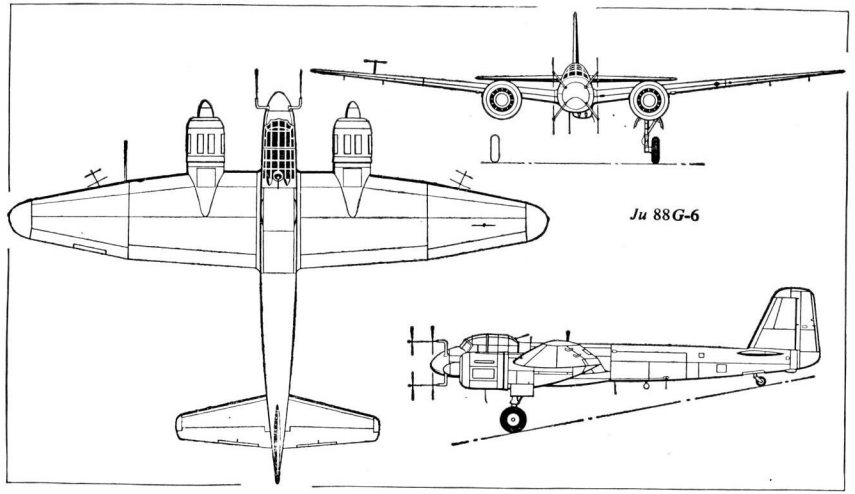
The final production G-series model was the Ju 88G-7 powered by Jumo 213E engines. The G-7a had FuG 220 radar; the G-7b had a Morgenstern radar array, this being enclosed by a pointed wooden cone on some machines, and the G-7c had FuG 244 Bremen-0 centimetric radar. One other version of the Ju 88 saw production for the fighter role, the Ju 88H-2 long-range heavy fighter which saw

The Ju 88G-6b differed from the G-1 principally in having BMW 801G air-cooled radial engines in place of the BMW 801Ds.





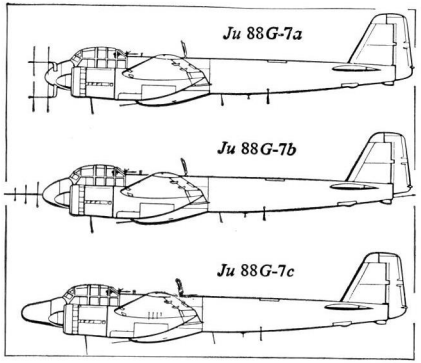
The Ju 88G-1, powered by BMW 801D radials, adopted the vertical tail surfaces of the Ju 188 bomber.



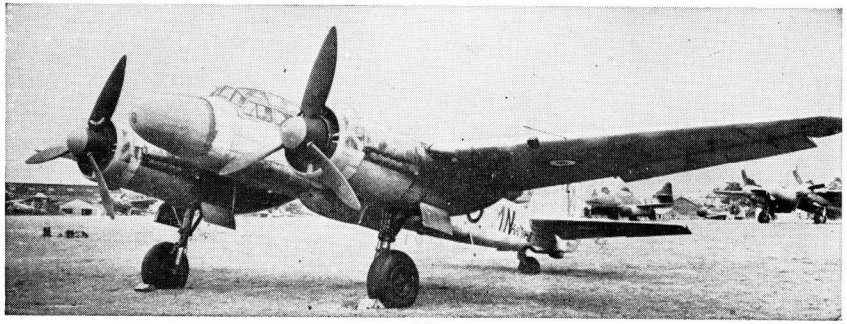
service over the Atlantic during 1942–43. Only ten aircraft of this type were produced, these being essentially A- and D-series airframes with elongated fuselages enabling additional fuel cells to be installed fore and aft of the wing.

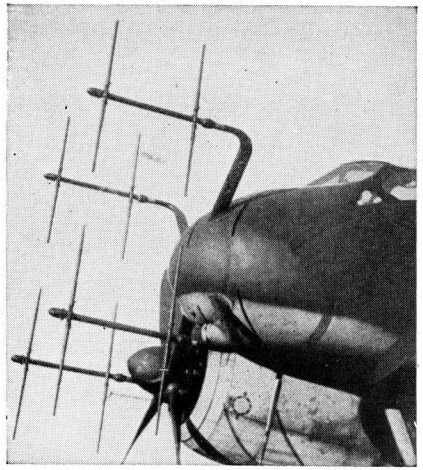
The following specification relates to the final G-series production model, the Ju 88G-7.

Type: *Four-seat Night Fighter.* **Power Plants:** *Two 1,725 h.p. Junkers Jumo 213E-1 twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Four forward-firing 20-mm. MG 151 cannon with 200 r.p.g. in ventral fairing, one rear-firing 13-mm. MG 131 machine gun with 500 rounds, and two MG 151 with 200 r.p.g. firing obliquely upward.* **Performance:** *Maximum speed, 270 m.p.h. at sea level, 363 m.p.h. at 33,500 ft., (with emergency MW 50 boost, 389 m.p.h. at 29,800 ft.); endurance (maximum economical cruising speed), 3.72 hrs. at 29,800 ft., (with 198 Imp. gal. drop tank, 5.2 hrs.); initial climb rate, 1,655 ft./min.; service ceiling, 28,800 ft.* **Weights:** *Normal loaded, 28,900 lb. maximum loaded, 32,350 lb.* **Dimensions:** *Span, 65 ft. 10½ in.; length, 54 ft. 1½ in.; height, 15 ft. 11 in.; wing area, 590 sq. ft.*



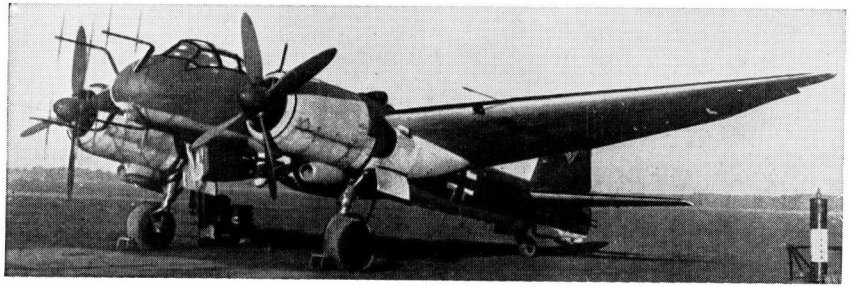
The last G-series production model, the Ju 88G-7c with FuG 244 Bremen-0 centimetric radar

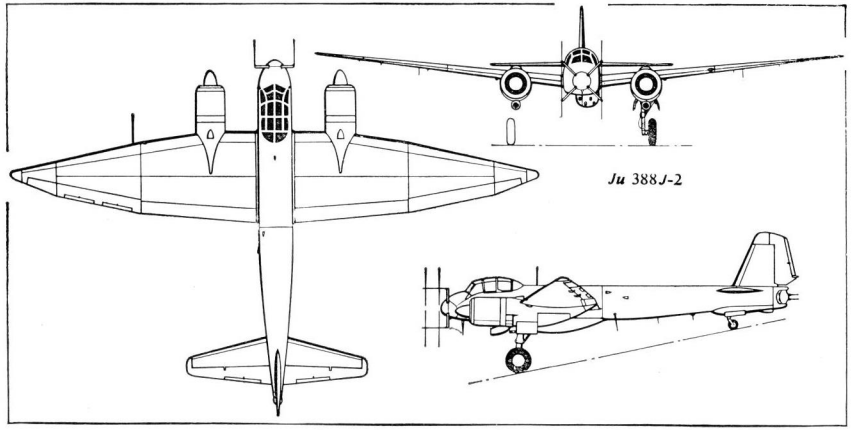




Allocated the highest production priority in an attempt to combat the R.A.F.'s high-altitude, night-flying Mosquitos, the Ju 388J Störtebeker was one of the last variants of the prolific Ju 88 series to be placed in production before Germany's defeat. Based on the final developments of the Ju 188, which had featured pressure cabins for high-altitude operation, the Ju 388 employed a similar basic airframe to that of the earlier type but was fitted with BMW 801TJ engines with exhaust-driven turbo-superchargers. The first prototype, the Ju 388V1, was converted from a Ju 188T-0 at Merseburg, and flown for the first time late in 1943. This was a high-altitude photo-reconnaissance aircraft which entered production as the Ju 388L, but the second prototype, the Ju 388V2, was a night fighter prototype for the production Ju 388J Störtebeker.

Equipped with an FuG 220 radar array in the nose and mounting an armament of two 20-mm. MG 151 cannon with 180 r.p.g. and two 30-mm. MK 103 cannon with 110 r.p.g. in a ventral tray offset to port, and twin 13-mm. MG 131 machine guns with 300 r.p.g. in





a remotely-controlled FDL 131Z tail barbette, the Ju 388V2 proved a formidable warplane, and parallel production of the Ju 388J fighter, the Ju 388K bomber and the Ju 388L reconnaissance aircraft was started. However, only three Ju 388J-1 fighters had been delivered when the termination of hostilities brought the assembly line to a halt.

The Ju 388J-1 was essentially similar to the V2 apart from the deletion of the FDL 131Z tail barbette, rendered necessary by delays in the delivery of this armament, but the Ju 388J-2 was to have received the tail barbette, while the projected Ju 388J-3 was to have had a pointed wooden nose cone with Morgenstern radar and two additional MG 151 cannon in a "Shräge Musik" arrangement, the guns firing obliquely upwards. It was proposed to power later production Ju 388J-3 fighters with 1,725 h.p. Jumo 213E liquid-cooled engines with MW 50 methanol-water injection. The specification relates to the Ju 388J-1.

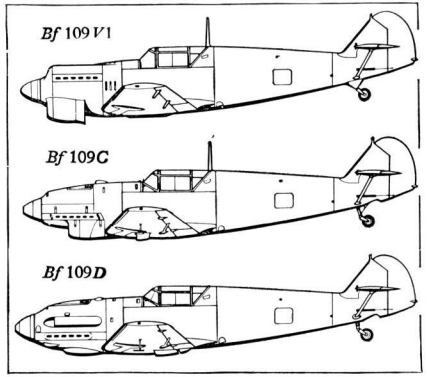
Type: *Four-seat High-altitude Night Fighter.* **Power Plants:** *Two* 1,810 *h.p. BMW* 801*TJ fourteen-cylinder two-row air-cooled radial engines.* **Armament:** *Two* 20-*mm. MG* 151 *cannon and two* 30-*mm. MK* 103 *or MK* 108 *cannon.* **Performance:** *Maximum speed,* 249 *m.p.h. at sea level,* 362 *m.p.h. at* 40,300 *ft.; endurance, at maximum continuous power,* 3.02 *hrs. at* 36,100 *ft.,* 3.03 *hrs. at* 26,300 *ft., maximum economical cruising,* 3.69 *hrs. at* 36,100 *ft.,* 4.45 *hrs. at* 26,300 *ft.; initial climb rate,* 1,240 *ft./min.; time to* 26,300 *ft.,* 21 *min., to* 36,100 *ft.,* 34.5 *min.; service ceiling,* 42,600 *ft.* **Weights:** *Normal loaded,* 30,700 *lb.; maximum,* 32,350 *lb.* **Dimensions:** *Span,* 72 *ft.* 2 *in.; length,* 49 *ft.* 0½ *in.; wing area,* 602 *sq. ft.*

MESSERSCHMITT BF 109E

GERMANY

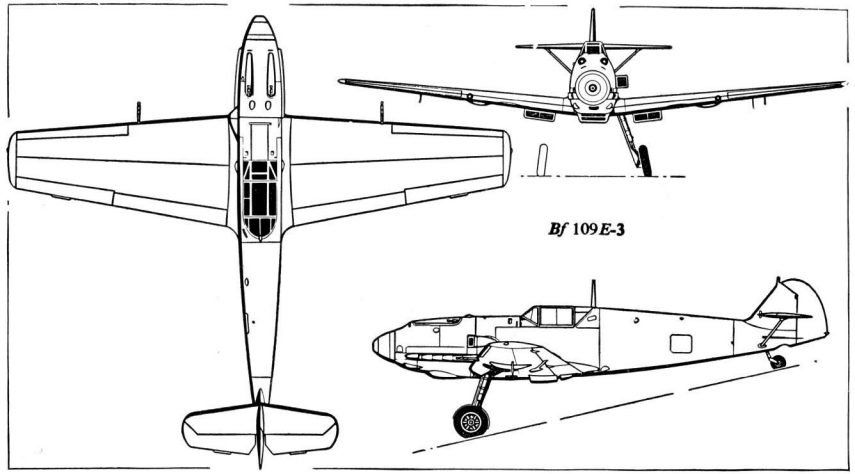
Designed by Professor W. Messerschmitt and manufactured by the Bayerische Flugzeugwerke A.G., the forerunner of the Messerschmitt A.G., the Bf 109 single-seat fighter was to gain the distinction of being manufactured in larger quantities than any other warplane of the Second World War. Variants of this fighter accounted for more than sixty per cent of all single-seat fighter production in Germany during 1936–45, and in 1939 the Bf 109E is generally conceded to have been superior to any other fighter extant, with the possible exception of the Supermarine Spitfire.

On the eve of the commencement of hostilities the bulk of the Luftwaffe's single-seat fighter squadrons were equipped with the Bf 109E, 850 machines of this type being included in the first-line strength, together with 235 examples of the earlier Bf 109D which was in process of being phased out of first-line service. The Bf 109E was the fourth basic service version of a fighter designed to meet the requirements of a Reichsluftfahrtministerium specification prepared late in 1933, and issued to the German aircraft industry in 1934. The first prototype, the Bf 109V1 (Werk-Nr. 758) registered D-IABI, was powered by a 695 h.p. Rolls-Royce Kestrel V engine and flown for the first time in September 1935, competed against the Heinkel He 112, the Arado Ar 80 and the Focke-Wulf Fw 159 at Travemünde during the following month.



The second prototype, the Bf 109V2 (Werk-Nr. 809) registered D-IUDE, flew in January 1936 with a 610 h.p. Junkers Jumo 210A engine, being followed in June by the similarly powered Bf 109V3 (Werk-Nr. 810, D-IHNY). These had provision for an armament of two 7.9-mm. MG 17 machine guns, which was that proposed for the production Bf 109A, but changes in R.L.M. requirements led to the installation of three MG 17 machine guns in the Bf 109V4 (Werk-Nr. 878, D-IOQY), one of which was later supplanted by an engine-mounted 20-mm. MG FF cannon. The Bf 109V5 and V6 were intended as production prototypes for the Bf 109B, carrying three MG 17 machine guns and powered by the 610 h.p. Jumo 210B engine. To gain experience with the new fighter under operational conditions, the Bf 109V4 was sent to Spain in December 1936, the V5 and V6 following shortly afterwards. These commenced operational trials from Tablada, Seville, early in 1937

In the meantime, the Bf 109V7 had flown—this being similar to the V5 and V6—and official trials had commenced with the pre-production Bf 109B-0. The initial production



model, the Bf 109B-1, was issued to Jagdgeschwader 2 during the late spring of 1937, this model having a 650 h.p. Jumo 210Da engine with which a maximum speed of 292 m.p.h. was attained at 13,120 ft. The Bf 109B-2 was similar apart from the installation of a 680 h.p. Jumo 210Ea engine with two-stage supercharger and a Hamilton two-blade variable-pitch metal airscrew. Some Bf 109B-2s were powered by the 700 h.p. Jumo 210G, and some twenty-four aircraft of this type were sent to Spain during the spring of 1937 to re-equip the first and second staffeln of Jagdgruppe 88 fighting with the Condor Legion.

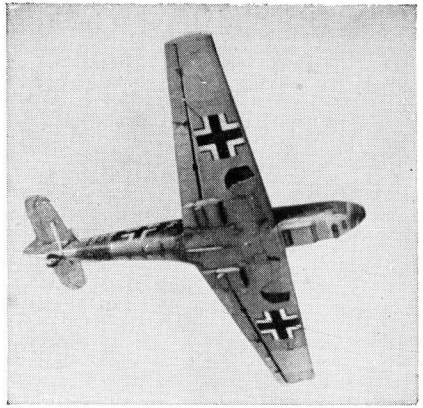
The Bf 109V8 (Jumo 210Da) carried four MG 17 machine guns, two mounted over the engine and two in the wings, and was the first prototype for the Bf 109C; the Bf 109V9 had a 20-mm. MG FF cannon mounted experimentally in each wing root, and the Bf 109V10 was powered initially by a Jumo 210Ga and later by a 1,000 h.p. Daimler-Benz DB 600Aa. The pre-production Bf 109C-0 and production C-1 were similar to the Bf 109B-2 apart from the armament of four MG 17 machine guns, and were powered by the Jumo 210G. The Bf 109C-2 had an additional MG 17 firing through the airscrew hub, and the experimental C-4 had an engine-mounted 20-mm. MG FF cannon. Twelve Bf 109C-1 fighters reached Spain early in 1938 to re-equip Jagdgruppe 88's third staffel.

The most important sub-type of the Bf 109*E fighter during the epic "Battle of Britain" was the E*-3 *(above).*

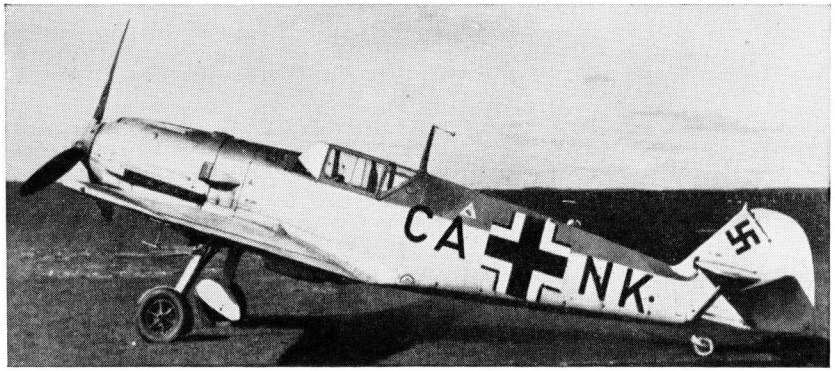
The Bf 109V11 and V12 were former B-0 airframes structurally strengthened to take the DB 600Aa engine rated at 1,000 h.p. for take-off and 910 h.p. at 13,120 ft., these serving as prototypes for the production Bf 109D. The Bf 109V13 (D-IPKY) was a development aircraft initially powered by the DB 600Aa with which it won the Alpine Circuit and dive-and-climb contests at the International Flying Meeting held at Zurich in July 1937. Later re-engined with a specially-boosted DB 601A engine delivering 1,650 h.p. for short periods,

this aircraft established a new international speed record for landplanes on November 11. 1937 with a speed of 379.38 m.p.h. The pre-production Bf 109D-0 fighters for service trials were actually converted B-series airframes similar to the Bf 109V11 and V12, and these were followed by the Bf 109D-1 which carried an armament of one engine-mounted MG FF cannon and two MG 17 machine guns, and, powered by the DB 600Aa, attained a speed of 323 m.p.h. at rated altitude.

By the end of 1938 the Bf 109D-1 had been supplanted on the production lines by the Bf 109E, the first true prototype for which was the Bf 109V14 (D-IRTT) flown in the summer of 1938. This carried two wing-mounted MG FF cannon and two MG 17 machine guns mounted over the engine, and was powered by the DB 601A rated at 1,100 h.p. and incor-



(Below) The Bf 109*E*-1, *and (right) the Bf* 109*E*-5.



porating direct fuel injection and improved supercharging capacity. The Bf 109V15 (D-IPHR) had a single engine-mounted MG FF cannon and no wing guns, and the pre-production Bf 109E-0 carried four MG 17 guns and no cannon.

The first production E-series model, the Bf 109E-1, began to reach Luftwaffe fighter units in the spring of 1939, initial production machines having the same armament as the Bf 109E-0s but later machines standardising on two 7.9-mm. MG 17s with 1,000 r.p.g. over the engine and two wing-mounted 20-mm. MG FF cannon with 60 r.p.g. A fighter-bomber variant, the Bf 109E-1/B, was fitted with racks for four 110-lb. bombs or one 550-lb. bomb, and employed the Revi gunsight as a bombsight. In September 1939 the Bf 109E-1 was standard Luftwaffe fighter equipment, but before the end of the year the improved Bf 109E-3 with the DB 601Aa engine and an additional MG FF cannon firing through the airscrew hub had reached the assembly lines, a production rate of 150 machines per month being achieved by the beginning of 1940. The engine-mounted cannon was deleted from the Bf 109E-4, a fighter-bomber variant of which was designated Bf 109E-4/B, and the Bf 109E-4/N was a similarly-armed fighter-bomber, the "N" suffix denoting the installation of the 1,200 h.p. DB 610N engine.

The Bf 109E-5 and E-6 were reconnaissance fighters, defensive armament being reduced to two MG 17 machine guns, the former having a DB 601Aa and the latter having a DB 601N. The Bf 109E-7 was a generally similar fighter to the E-4 apart from the use of the DB 601N engine and attachment points for a drop tank. Some machines of this type were converted for low-level attack duties in North Africa as the Bf 109E-7/U2, extra armour being bolted beneath the engine and coolant radiators, and the E-7/Z featured a GM 1 bi-fuel power-boosting system, nitrous oxide being injected into the supercharger above the rated altitude of the engine to provide additional oxygen and act as an anti-detonant. The final production E-series aircraft switched to the 1,300 h.p. DB 601E engine, these being the Bf 109E-8 fighter and the Bf 109E-9 reconnaissance aircraft, the latter carrying a 66 Imp. gal. drop tank and an RB 50/30 camera.

In 1940 the Fieseler-Werke undertook the modification of ten Bf 109E-3 fighters for use aboard the carrier *Graf Zeppelin* then under construction. Designated Bf 109T-0 (the "T" suffix indicating Träger or Carrier), the ship-board model featured an increase in wing area, spoilers on the wing upper surfaces, manually-folded outer wing panels, catapult spools and an arrester hook. Delays in the completion of the *Graf Zeppelin* resulted in the cancellation of the Bf 109T-0s which were reconverted to E-3 configuration.

The following specification refers to the Bf 109E-1.

It is a little-known fact that, during 1941–43, the Swiss Dornier-Werke manufactured the Bf 109E under licence, producing eight complete aircraft, seven additional fuselages and four additional pairs of wings.

Type: *Single-seat Fighter.* **Power Plant:** *One* 1,100 *h.p. Daimler-Benz DB* 601*A twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two* 20-*mm. MG FF cannon with* 60 *r.p.g. and two* 7.9-*mm. MG* 17 *machine guns with* 1,000 *r.p.g.* **Performance:** *Maximum speed,* 354 *m.p.h. at* 12,300 *ft.; initial climb rate,* 3,100 *ft./min.; time to* 16,500 *ft.,* 6.2 *min.; service ceiling,* 36,000 *ft.; absolute ceiling,* 37,500 *ft.; range* (62.5 *per cent power),* 412 *mls. at* 248 *m.p.h. at* 16,400 *ft.* **Weights:** *Empty,* 4,421 *lb.; loaded,* 5,523 *lb.* **Dimensions:** *Span,* 32 *ft.* 4½ *in.; length,* 28 *ft.* 4 *in.; height* 7 *ft.* 5½ *in.; wing area,* 174 *sq. ft.*

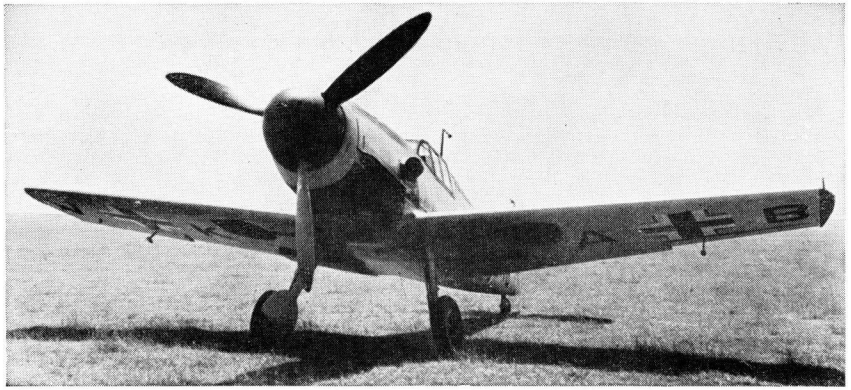
MESSERSCHMITT BF 109F — GERMANY

In the spring of 1940 an extensive programme of aerodynamic refinement was initiated on the basic Bf 109 design which was to result in the Bf 109F. A standard Bf 109E airframe (Werk-Nr. 5604) was fitted with a 1,300 h.p. Daimler-Benz DB 601E-1 engine housed in an entirely redesigned, symmetrical cowling. The supercharger air intake was redesigned and positioned further out from the engine cowling in order to increase the ram effect, an enlarged airscrew spinner was fitted, and the diameter of the airscrew was reduced by some six inches. Shallower underwing radiators incorporating boundary layer bypasses were adopted, and the braced tailplane was replaced by a cantilever unit. With these modifications, the experimental Bf 109E flew for the first time on July 10, 1940, at Augsburg-Haunstetten.

All these changes were incorporated in the Bf 109F and, in addition, the wing planform was modified, rounded wingtips supplanting the clipped tips featured by all earlier models, Frise-type ailerons taking the place of the slotted ailerons, and plain flaps of reduced area replacing the slotted flaps. The rudder was altered in shape and decreased in size, and a fully-retractable tailwheel was adopted. All these modifications were tested on experimental Bf 109Es before being incorporated in the pre-production Bf 109F-0 evaluated by the Luftwaffe during the late months of 1940.

The first production version of the new model, the Bf 109F-1, began to reach operational units in January 1941, and, although

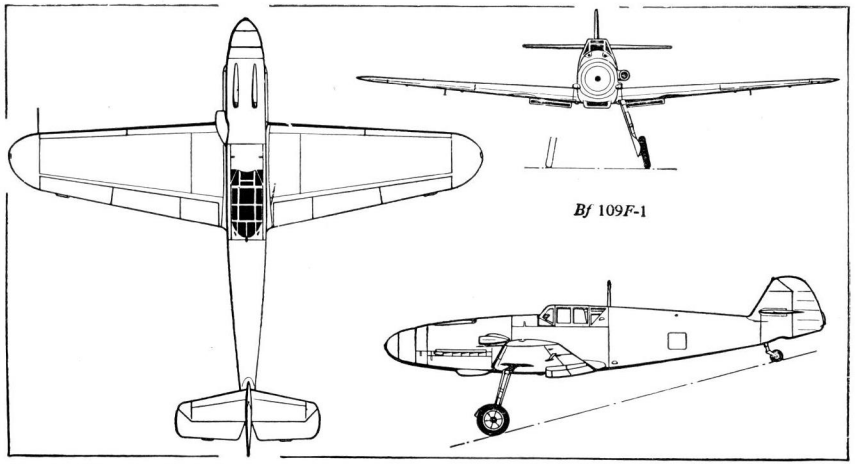
Bf 109*E* (*Werk-Nr.* 5604) *served as a prototype for the Bf* 109*F but retained the E-series wing.*



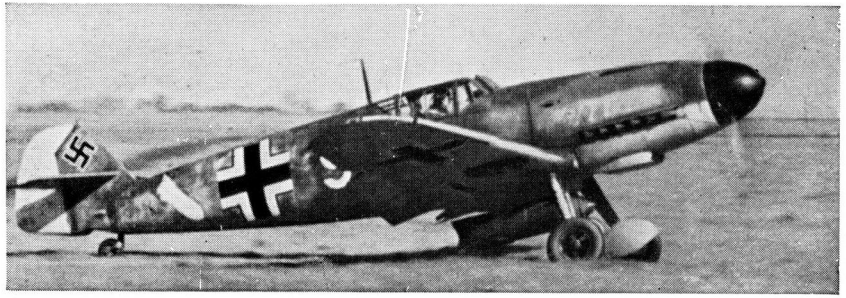
The Bf 109F-1 (above) outclassed the Spitfire V at altitude and was markedly superior to the Bf 109E.

some trouble was experienced with tail spar failures during the new fighter's early service months, modifications eliminated this fault and the Bf 109F soon proved an excellent fighter, outclassing the Spitfire V at altitude. The Bf 109F-1 was powered by a 1,200 h.p. DB 601N engine and carried an armament of one engine-mounted 20-mm. MG FF cannon and two 7.9-mm. MG 17 machine guns. The Bf 109F-2 differed solely in having the MG FF cannon replaced by a 15-mm. MG 151 cannon which possessed a higher velocity and better trajectory. The Bf 109F-2/Z and F-2/Trop were respectively versions with GM 1 power boost and tropical filters, the latter being employed in North Africa. The Bf 109F-3 which appeared on the production lines early in 1942 switched to the DB 601E engine, and the F-4 had the engine-mounted 15-mm. cannon replaced by a 20-mm. MG 151, the F-4/B and F-4/Trop being fighter-bomber and tropicalised models. Some leading German fighter pilots believed the armament of the Bf 109F to be inadequate and, in consequence, the Bf 109F-4/R1 was introduced, this having a 20-mm. MG 151 cannon mounted in a gondola beneath each wing. Owing to the adverse effect on the fighter's manoeuvrability, the underwing cannon were not generally adopted.

The Bf 109F-5 was used principally for long-range reconnaissance duties, carrying a



The Bf 109F-4/B (below) was a DB 601E-powered fighter-bomber employed for "sneak raids" over Britain.



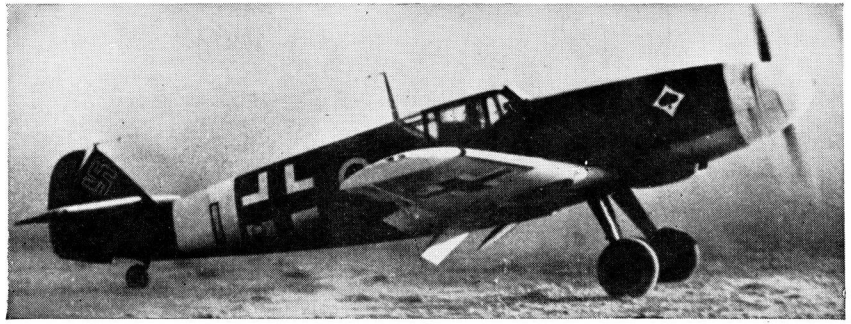
66 Imp. gal. drop tank, armament being reduced to two MG 17 machine guns, and the F-6 was a further reconnaissance variant which, usually carrying no armament, had an RB 50/30, RB 20/30 or RB 75/30 camera in place of the radio.

Several F-model airframes were employed for experimental purposes. One was fitted with boundary layer fences for comparison with the leading edge slots; one was fitted with Vee-type tail surfaces; one had an elongated wing for high-altitude trials; one was fitted with a BMW 801 radial engine for comparative trials with the Fw 190A, and two others were fitted with single and twin nosewheels. The most interesting experimental version was, however, the Bf 109Z which comprised two Bf 109F-1 fuselages married by means of a new wing centre section and tailplane. It was originally proposed that this machine should act as a prototype for a heavy fighter-bomber utilising a similar arrangement of Bf 109G components. The pilot was to have sat in the port fuselage, and cannon armament was to have consisted of five 30-mm. MK 108 guns. In the event, the completed airframe was shelved without flight testing.

The following specification refers to the Bf 109F-3.

Type: *Single-seat Fighter.* **Power Plant:** *One* 1,300 *h.p. Daimler-Benz DB* 601*E*-1 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *One* 15-*mm. MG* 151 *cannon with* 200 *rounds and two* 7.9-*mm. MG* 17 *machine guns with* 500 *r.p.g.* **Performance:** *Maximum speed,* 390 *m.p.h. at* 22,000 *ft.; cruising speed,* 310 *m.p.h. at* 16,500 *ft.; maximum climb rate,* 3,320 *ft./min. at* 5,000 *ft.; service ceiling,* 37,000 *ft.; normal range,* 440 *mls.; endurance,* 1 *hr.* 24 *min.* **Weights:** *Empty,* 4,330 *lb.; loaded,* 6,054 *lb.* **Dimensions:** *Span,* 32 *ft.* 6½ *in.; length,* 29 *ft.* 0½ *in.; height,* 8 *ft.* 6 *in.; wing area,* 174.375 *sq. ft.*

A Bf 109*F*-4/*Trop of J.G.*53, *the Pikas Jagdgeschwader, in North Africa in 1942.*



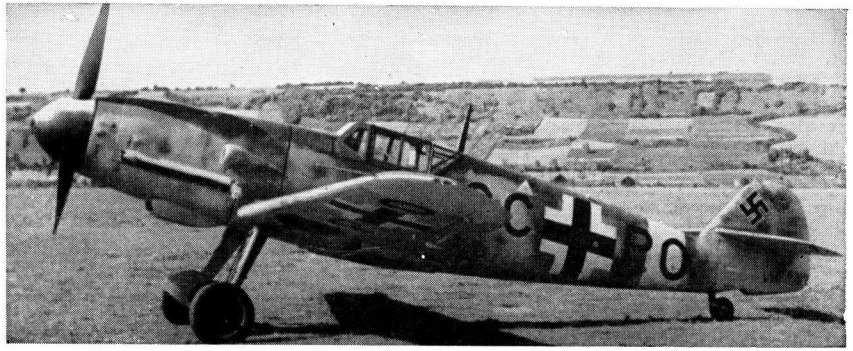
MESSERSCHMITT BF 109G

GERMANY

The Bf 109 single-seat fighter was subjected to an infinite succession of modifications throughout World War II, but with the phasing out of the F-series the basic design had passed its development peak, and the Bf 109G, which had almost entirely supplanted earlier models of the Bf 109 by the end of 1942, was regarded by many as an inferior aeroplane to its immediate predecessor. Constant operational demands for increased fire power and additional equipment resulted in substantial increases in combat weight and drag and, with no commensurate increases in power and lift, flying characteristics suffered.

The most important change between the F- and G-series fighters was the introduction of the 1,475 h.p. Daimler-Benz DB 605A engine, although this was not available for installation in the pre-production Bf 109G-0, and the twelve machines of this type completed retained the lower-powered DB 601E. The Bf 109G-0 and the first production model, the Bf 109G-1, were equipped with pressurized cockpits, the latter having the DB 605A engine, and armament consisted of one 20-mm. MG 151 cannon and two 7.9-mm. MG 17 machine guns. A tropicalised version, the Bf 109G-1/Trop, had the MG 17s replaced by 13-mm. MG 131s, their installation necessitating the provision of fairings on the gun breeches. The Bf 109G-2 was similar to the G-1 but had no pressure cabin and was intended for the reconnaissance role. Forward firing armament was reduced to two MG 17s, and a service test group equipped with this type and based at Guyancourt experimented with a ventral gun pack containing two rearward-firing MG 17s. The Bf 109G-3 was also similar

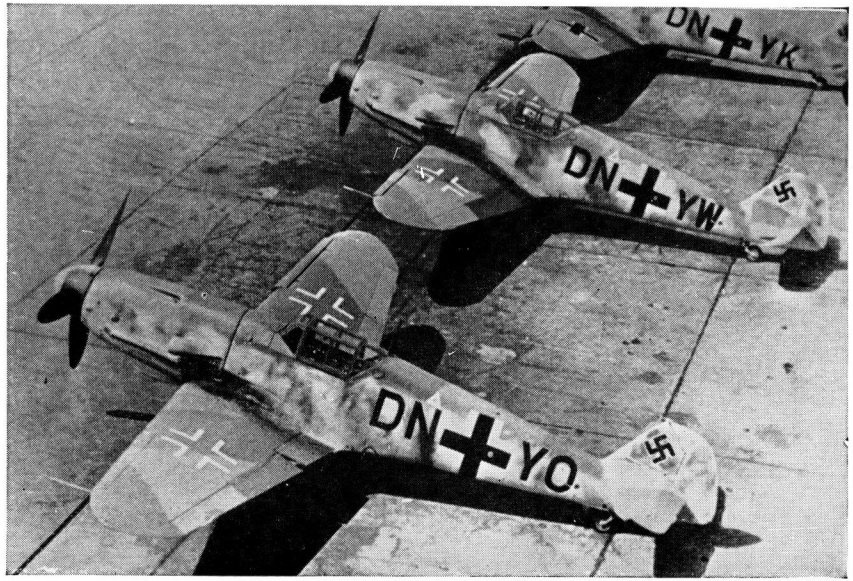
Delays in the delivery of DB 605*A engines resulted in the installation of the DB* 601*E in the Bf* 109*G*-0 *(below).*

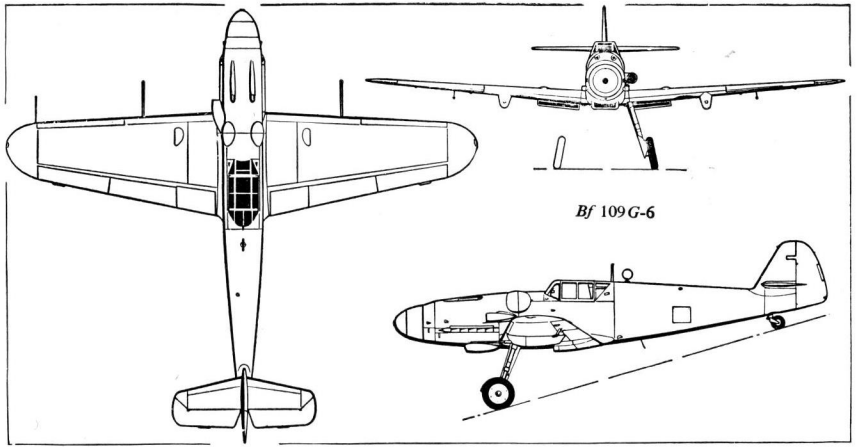


to the G-1 but had FuG 16Z radio in place of the earlier FuG 7A, while the G-4 was an unpressurised version of the G-3.

The Bf 109G-5 standardised on an armament of two MG 131s and one MG 151, and was powered by the DB 605D engine with a larger supercharger and methanol-water injection boosting power to 1,800 h.p. at sea level. The Bf 109G-5/R2 was fitted with a taller fin and rudder assembly of wooden construction and a lengthened tailwheel, and the Bf 109G-6 was the first production model to augment its armament with a 20-mm. MG 151 cannon under each wing. This model could be powered by the DB 605AM, AS, ASB, ASM or D. The Bf 109G-6/U4 carried two 30-mm. MK 108 cannon underwing, and the G-6/U4N was a night-fighting variant with "Naxos Z" warning and homing receivers with a rotating antenna aft of the cockpit. The Bf 109G-6/R1

Early production Bf 109G-1 fighters awaiting delivery to Luftwaffe units in 1942.

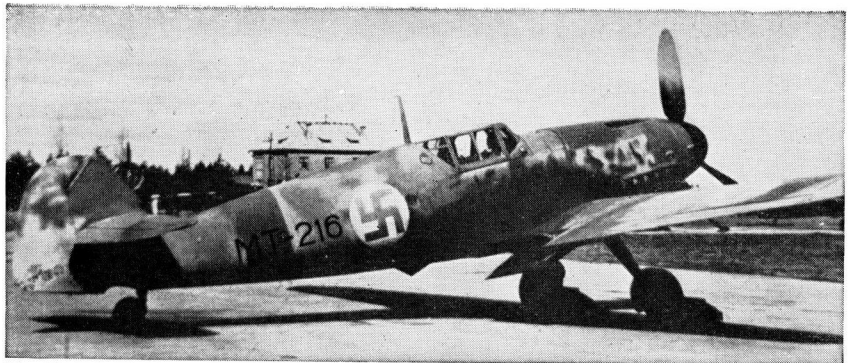




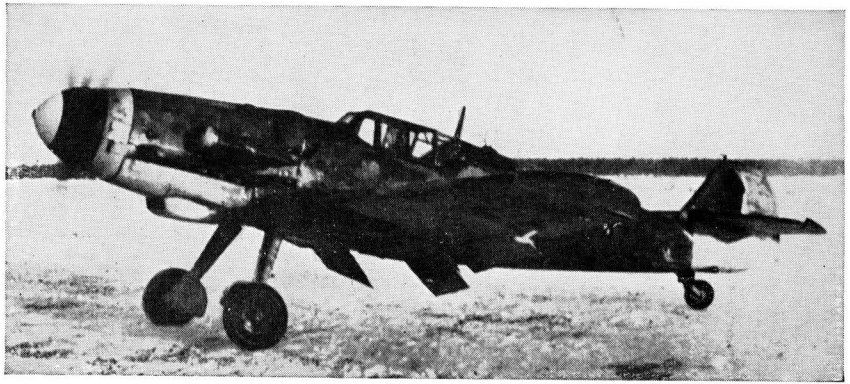
was a fighter-bomber conversion carrying one 550-lb. or 1,100-lb. bomb, and the G-6/R2 carried two WG 21 rocket tubes underwing—each containing one 21-cm. missile. The Bf 109G-7 was a proposed modification in which all the successive improvements to the G-6 became standard, but this type did not reach production status.

By July 1943, no less than 725 Bf 109Gs were being produced per month, and 6,418 machines were delivered during the year, production increasing to 14,212 in 1944. Production of the Bf 109G was also undertaken in Hungary and Rumania, Hungarian factories at Györ and Budapest delivering several hundred machines before production terminated in September 1944, but the Rumanian factory at Brasov actually building only sixteen before May 1944 when an Allied air attack destroyed production facilities.

The Bf 109G-8 was a fast reconnaissance aircraft which reverted to the original tail assembly and carried an RB 12.5/7 or RB 32/7 camera, but the fastest fighter sub-type was the Bf 109G-10 which, powered by the DB 605G and having MW 50 power boost equipment, attained maximum speeds of 344 m.p.h. at sea level and 428 m.p.h. at 24,250 ft. An altitude of 20,000 ft. was attained in six minutes, and range and endurance were 350 miles and 55 minutes respectively. Armament comprised two 13-mm. MG 131s with 300 r.p.g. and one 30-mm. MK 108. The Bf 109G-10/U4 had two MK 108s with 80 r.p.g.



The Finnish Air Force received thirty Bf 109G-2 fighters (above) and 132 Bf 109G-6s (below) for operation against the Russians. Most Finnish squadrons were equipped with the Bf 109G by the Russian offensive of June '44.



Bf 109G-6/R2 fighters with 21-cm. rocket tubes underwing These each contained one missile.

in a belly tray which was later replaced by a non-jettisonable fuel tank, and the G-10/R2 and R6 received the new wooden tail assembly, a counter-balance weight being bolted to the oil tank bracket, geared aileron and elevator tabs, elongated tailwheel leg, FuG 25a equipment for friend-foe identification, and a modified cockpit canopy known as a "Galland hood".

Several G-series airframes were fitted with a second seat as Bf 109G-12 operational trainers, and the last of the G-series to attain operational status was the Bf 109G-14 fighter-bomber powered by the DB 605A, AM, AS, ASB, ASM or ASD and normally armed with one 20-mm. MG 151 and two 13-mm. MG 131s. Two additional MG 151s under the outer wing panels were optional, and a carrier for a 550-lb. bomb was normally fitted. The G-14/Trop was a tropicalised version, and the G-14/R2 received the new wooden tail unit but retained the original short tailwheel leg. The final production model, the Bf 109G-16, which was too late to see operational service, retained the old-type cockpit canopy and was heavily armoured for the close-support role.

The following specification refers to the Bf 109G-6.

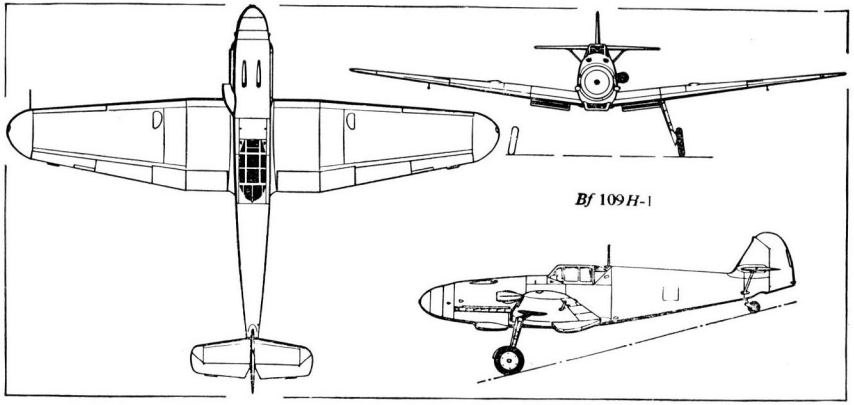
Type: *Single-seat Fighter.* **Power Plant:** *One 1,475 h.p. Daimler-Benz DB 605A-1 twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two 13-mm. MG 131 machine guns with 300 r.p.g., one engine-mounted 20-mm. MG 151 cannon with 150 rounds, and two 20 mm. MG 151 cannon mounted underwing with 120 r.p.g.* **Performance:** *Maximum speed, 387 m.p.h. at 22,970 ft., 338 m.p.h. at sea level; time to 19,000 ft., 6 min.; service ceiling, 38,500 ft.; maximum ceiling, 39,750 ft.; range, 450 mls. at 330 m.p.h. at 19,000 ft., 615 mls. at 260 m.p.h. at 19,000 ft.* **Weights:** *Empty, 5,900 lb.; normal loaded, 6,950 lb.; maximum loaded, 7,500 lb.* **Dimensions:** *Span, 32 ft. 6½ in.; length, 29 ft. 8 in.; height, 8 ft. 6 in.; wing area, 174.375 sq. ft.*

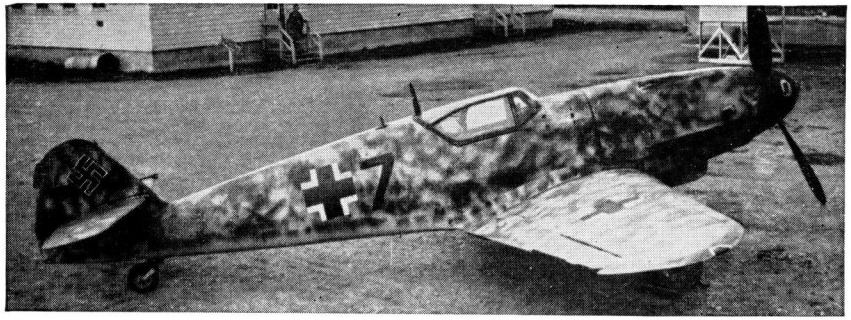
MESSERSCHMITT BF 109H AND K

GERMANY

During 1943 development of a specialised high-altitude version of the basic Bf 109 fighter commenced. A constant-chord centre section which increased overall span by 6 ft. 6 in. was incorporated between the outer wings, and the tailplane was reinforced by bracing struts similar to those employed by all production models of the fighter produced prior to the appearance of the Bf 109F. The high-altitude variant was designated Bf 109H, and a number of pre-production Bf 109H-0 high-altitude reconnaissance fighters were produced by the conversion of Bf 109F airframes, these, together with a small number of Bf 109H-1 production machines, being employed for service evaluation by a fighter-reconnaissance unit in 1944 from Guyancourt, near Paris.

The Bf 109H-1 was powered by a 1,300 h.p. DB 601E-1 engine with GM 1 power boost equipment and, with a 39 ft. 1¼ in. wing span, attained an altitude of approximately 47,000 ft. Armament comprised one engine-mounted 30-mm. MK 108 cannon and two 7.9-mm. MG 17 machine guns. Several developments were proposed, including the Bf 109H-2 with a Junkers Jumo 213E "power egg" and the Bf 109H-5 with a DB 605L. The H-2 was projected in two versions; one fitted with an RB 50/30 or RB 75/30 camera and no armament, and the other with one engine-mounted MK 108 cannon, two 20-mm. MG 151 cannon above the engine, and two 30-mm. MK 108 cannon under the wings. Both versions were to have had pressure cabins and were tendered in 1943, but service testing of the Bf 109H-0 and H-1 in the spring of 1944 was not entirely





The Bf 109K-6 (above) was one of the last production models of the basic Bf 109 fighter.

satisfactory, serious flutter developing in a dive, and further development was abandoned in favour of the Focke-Wulf Ta 152.

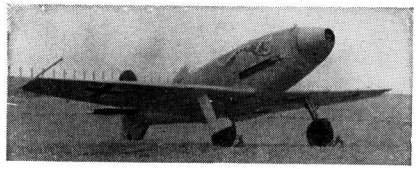
The suffix letter "I" was not allocated, and "J" was applied to the version to be manufactured under licence in Spain by Hispano Aviacion. The final German production model was, thus, the Bf 109K, which was essentially similar to the Bf 109G but incorporated minor structural differences. The pre-production Bf 109K-0s were converted from standard G-series airframes in the early autumn of 1944, and these were powered by the DB 605D with GM 1 (nitrous oxide) injection. Four sub-types were produced; the Bf 109K-2 and K-4 powered by the DB 605ASCM/DCM with MW 50 (methanol) injection boosting take-off power from 1,550 h.p. to 2,000 h.p., the similarly-powered Bf 109K-6, and the DB 605L-powered Bf 109K-14. The K-2 and K-4 differed solely in that the latter had a pressurized cabin, both carrying an armament of two 15-mm. MG 151s and one 30-mm. MK 103 or MK 108. The Bf 109K-6 carried two 13-mm. MG 131s and three 30-mm. MK 103s, and the K-14 had two MG 131s and one MK 108. The Bf 109K-2 and K-4 made their operational début during the Luftwaffe sortie against Allied airfields on January 1, 1945, but the Bf 109K-14 was too late to see operational usage.

The following specification refers to the Bf 109K-4.

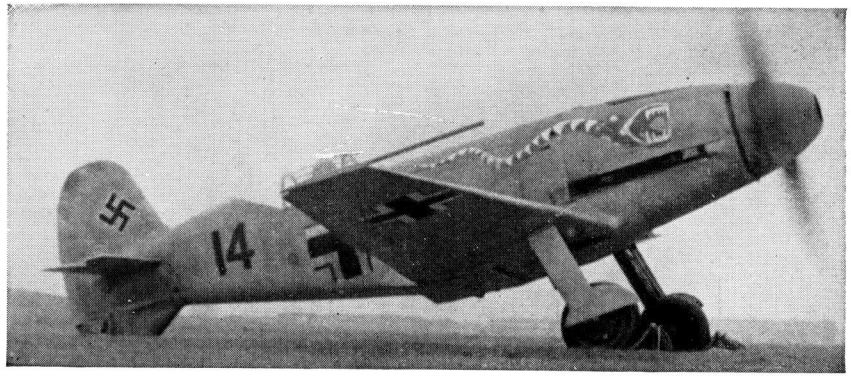
Type: *Single-seat Fighter.* **Power Plant:** *One 1,550 h.p. Daimler-Benz DB 605ASCM/DCM twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *Two 15-mm. MG 151 cannon and one 30-mm. MK 103 or 108 cannon.* **Performance:** *Maximum speed, 377 m.p.h. at sea level, 452 m.p.h. at 19,685 ft.; range (at 6,834 lb.), 355 mls. at 19,685 ft.; initial climb rate, 4,823 ft./min.; time to 16,400 ft., 3 min., to 32,800 ft., 6.7 min.; service ceiling (at 7,438 lb.), 41,000 ft.; range, 365 mls.; endurance, 50 min.* **Weights:** *Maximum loaded, 7,438 lb.* **Dimensions:** *Span, 32 ft. 6½ in.; length, 29 ft. 4 in.; height, 8 ft. 6 in.; wing area, 174.375 sq. ft.*

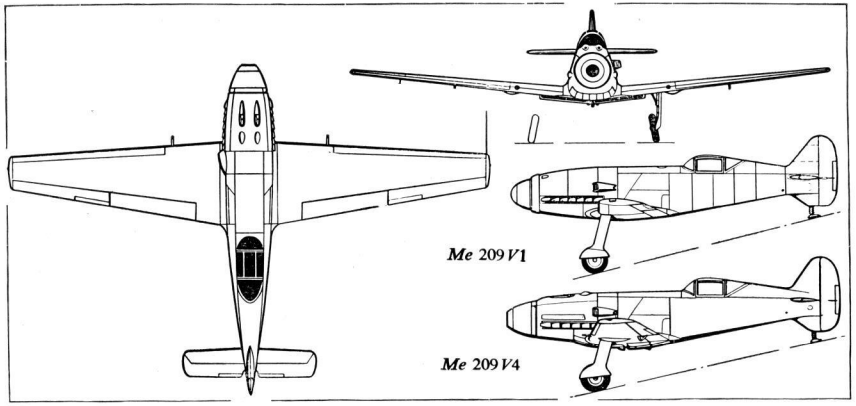
During 1937 Messerschmitt initiated work on the design of a high-speed aircraft intended to establish a new world air speed record. The project was known as P.1059, and when work started on the construction of three prototypes the aircraft received the designation Me 209.

The first prototype, the Me 209V1 (D-INJR), was first flown on August 1, 1938, and employed surface evaporation cooling instead of orthodox radiators in order to reduce drag. The Me 209V2 (D-IWAH) flew for the first time on February 8, 1939, but was destroyed eight weeks later, on April 4, 1939. The third prototype, the Me 209V3 (D-IVFP), with which it was planned to establish the new record, flew at the end of May 1939, but prior to the appearance of this aircraft a new international air speed record of 469.22 m.p.h. had been established by the Me 209V1. For the record-breaking flight the aircraft had been fitted with a specially uprated DB 601R engine which gave 2,300 h.p. for short bursts of speed.



Despite the poor flying characteristics displayed by the high-speed Me 209 prototypes during flight trials, work on a fighter variant, the Me 209V4 (D-IRND) had been proceeding in parallel, and this aircraft was first flown on May 12, 1939. Although the fuselage of the fighter was essentially similar to that of the high-speed aircraft, it employed an entirely new wing featuring automatic leading-edge slots. The surface evaporation cooling system was retained for the first eight test flights, but underwing coolant radiators were fitted for subsequent tests. These were soon found to provide inadequate cooling and were progressively increased in size, as was also the wing span. With each modification performance was reduced until it offered few advantages over that of the standard Bf 109F, and as handling demanded highly specialised training and the aircraft could be operated only from first-class airfields, the Reichsluftfahrtministerium lost interest in the further development of the design and work on the Me 209V4 was abandoned. There was no relationship between the Me 209V4 and the later Me 209V5.





Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,200 *h.p.* (1,270 *h.p. maximum emergency for one minute*) *Daimler-Benz DB* 601*N twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *One* 30-*mm. MK* 108 *cannon firing through the airscrew hub and two* 7.9-*mm. MG* 17 *machine guns mounted over the engine* (*attempts to install two additional MK* 108 *cannon in the wings were unsuccessful*). **Performance:** *Approximate maximum speed,* 375 *m.p.h. at* 20,000 *ft.; cruising speed,* 305 *m.p.h. at* 16,500 *ft.; maximum climb rate,* 3,700 *ft./min.; service ceiling,* 36,000 *ft.* **Weights:** *Loaded, initial,* 5,011 *lb., developed,* 6,173 *lb.* **Dimensions:** *Span, as initially flown,* 30 *ft.* 5¾ *in., final form as illustrated by general arrangement drawing,* 32 *ft.* 11¼ *in.; length,* 23 *ft.* 9 *in.; height,* —; *wing area,* —.

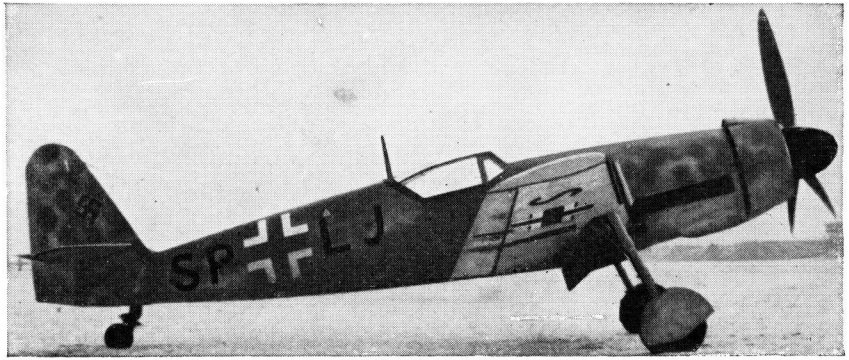
MESSERSCHMITT ME 209-II

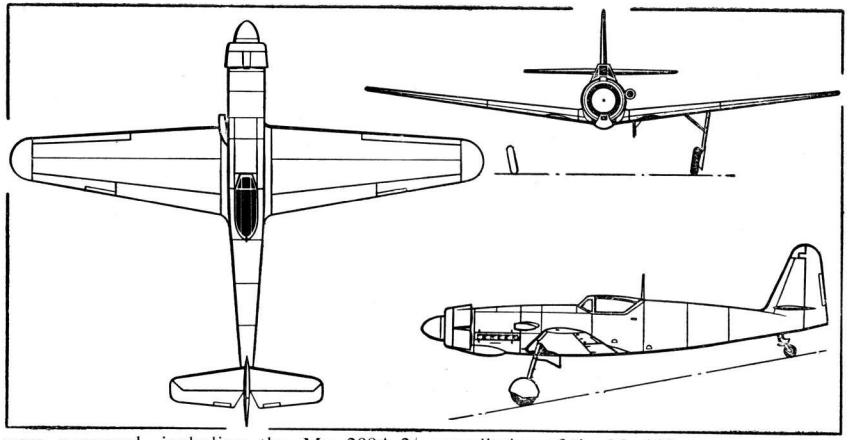
GERMANY

Despite the total failure of the Me 209V4 and the disappointing performance of the Me 309, the Messerschmitt A.G. was still determined to provide the successor to the Bf 109 in the Luftwaffe's fighter arm and a competitor for Focke-Wulf's Fw 190D and Ta 152 fighters. It was realised that no useful purpose could be served in attempting any further development of the original Me 209, and it was decided, therefore, to produce an entirely new fighter design which, in order to accelerate development and subsequent production, was to use a large proportion of standard Bf 109 components.

The new fighter was designated Me 209-II and was, in fact, a modernized, more powerful development of the Bf 109, and employed sixty-five per cent of the earlier fighter's components. The Me 209-II adopted an exceptionally wide-track, inward-retracting undercarriage. Another major change was the installation of a Daimler-Benz DB 603A-1 engine (eventually to be replaced by the DB 603G) with an annular radiator. Overall wing span was substantially increased and the vertical tail surfaces were enlarged, but apart from these changes, the Me 209-II was essentially similar to the Bf 109G.

The prototype for the Me 209-II fighter, the Me 209V5 (illustrated by the photograph and general arrangement drawing), was flown for the first time on November 3, 1943, by Flugkapitan Fritz Wendel, a second prototype flying on December 22, 1943, and tests revealed that the aircraft possessed an excellent performance and overcame most of the Bf 109's shortcomings. Shortages of the DB 603G engine resulted in an R.L.M. demand for the installation of the Jumo 213E. The design of the Jumo-powered model was completed in November 1943, and construction of a test aircraft, designated Me 209A-2, began the following month. Several production variants



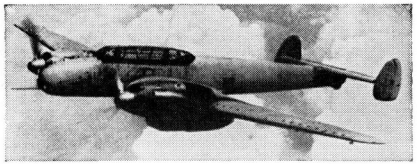


were proposed, including the Me 209A-2/R2U-1 with one MK 108 and two MG 151 cannon; the A-2/R2U-2 with two additional MK 108 or MG 151 cannon; the A-2/R2U-3 and -4, respectively similar to the -1 and -2 but fitted with GM-1 power boost, and the A-2/R2U-5 long-range fighter with an additional 66 gals. of fuel. Tests with the Me 209A-2 began in April–May 1944. By this time, however, the Fw 190D-9 was entering service with Jagdgeschwader 3, and as this fighter had a speed advantage of some 30 m.p.h. at altitude, and as the introduction of the Me 209-II would disrupt fighter deliveries at a critical phase of the air war, the Reichsluftfahrtministerium decided to discontinue the development of the Messerschmitt. The sole Me 209A-2 participated in the programme to test the suitability of the Jumo 213E as a high-altitude fighter power plant. Despite the cancellation of the Me 209 programme, however, a further prototype was completed. This, the Me 209HV1, had an extended wing and was to have been fitted with a DB 627 engine. In fact, it was completed with a DB 603G engine, and tests began in June 1944. Specification applies to Me 209A-2

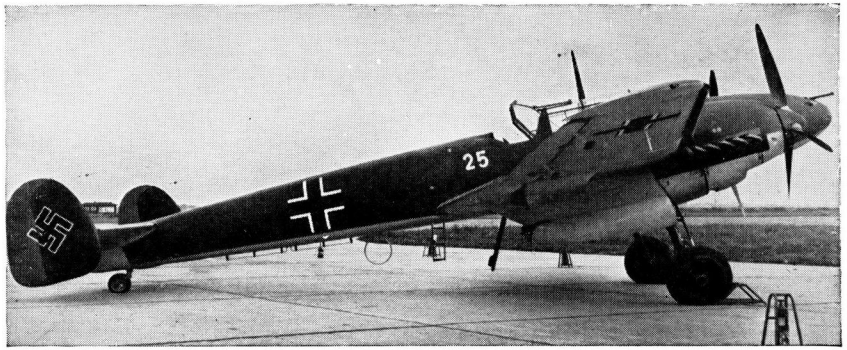
Type: *Single-seat Interceptor Fighter.* **Power Plant:** *One* 1,750 *h.p. Junkers Jumo* 213 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *One* 30-*mm. MK* 108 *and two* 20-*mm. MG* 151 *cannon.* **Performance:** *Maximum speed,* 410 *m.p.h. at* 19,685 *ft.,* 458 *m.p.h. at full boost altitude; cruising speed,* 302 *m.p.h.; service ceiling,* 42,650 *ft.* **Weights:** *Empty,* 7,659 *lb.; loaded,* 9,259 *lb.* **Dimensions:** *Span,* 35 *ft.* 11 *in.; length,* 31 *ft.* 6¾ *in.; height,* 11 *ft.* 8 *in.; wing area,* 184.6 *sq. ft.*

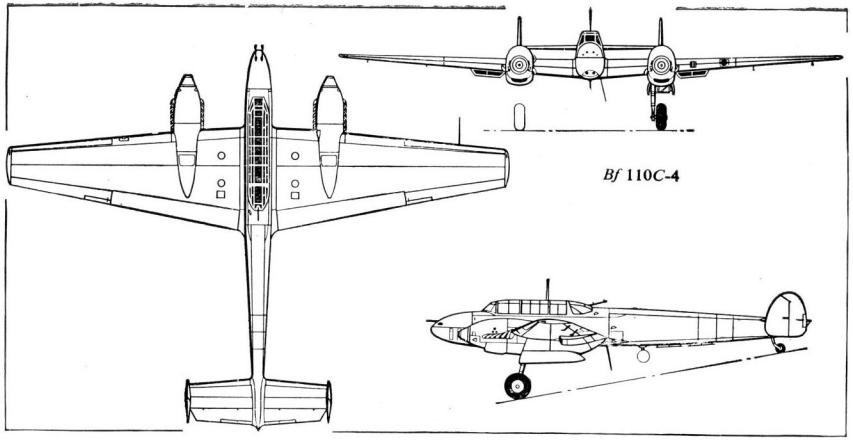
MESSERSCHMITT BF 110C-F GERMANY

The first serious attempt to produce a strategic fighter, an aircraft capable of accompanying bomber formations and penetrating deep into enemy territory, the Messerschmitt Bf 110 was designed to meet a requirement announced by the Reichsluftfahrtministerium in 1934, initial project drawings being prepared towards the end of that year. The Bf 110 was designed on the understanding that the new liquid-cooled DB 600 engines would be available for installation in the prototypes, work on three of which began at Augsburg in 1935, and the first prototype, the Bf 110V1, was flown on May 12, 1936. The V2 and V3 were flown respectively on October 24 and December 24, 1936, the second prototype being sent to the Rechlin test establishment for Luftwaffe trials on January 14, 1937. Although manoeuvrability was sluggish by comparison with smaller single-seat fighters, the DB 600-powered prototypes attained 316 m.p.h. in level flight and were, therefore, only marginally slower than the Hawker Hurricane which had preceded the Bf 110V1 into the air by just a few months. Daimler-Benz had still to bring the DB 600 engine to full production status, however, and the Bayerische Flugzeugwerke was, therefore, instructed to build four Bf 110A-0 fighters for service evaluation and power these with 610 h.p. Junkers Jumo 210B engines. Carrying a forward-firing armament of four 7.9-mm. MG 17 machine guns and a single rear-firing MG 15 of similar calibre, the Bf 110A-0 was seriously underpowered, and attained a maximum speed of only 267 m.p.h. at 12,470 ft.



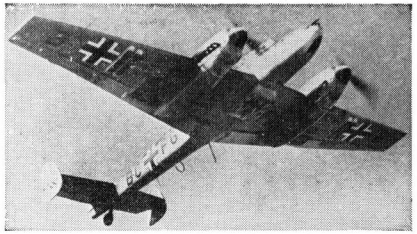
(Top, left) The Bf 110V1, (left) the Bf 110C-0, and (below) an early production Bf 110C-1.





In the spring of 1938, however, quantity deliveries of the DB 600A engine rated at 960 h.p. began, and two further airframes. which had been designated Bf 110B-0 and flown with 670 h.p. Jumo 210G engines, were fitted with DB 600As to serve as test vehicles for the initial production model of the fighter, the Bf 110B-1. The forward-firing armament of the Bf 110B-1 was increased to two 20-mm. MG FF cannon and four MG 17s, and it was proposed to evaluate these fighters under operational conditions in Spain, but the Spanish conflict had terminated by the time the machines were ready.

The abandoning of the DB 600A engine in favour of the more promising DB 601 with direct fuel injection and improved supercharging capacity limited production of the Bf 110B-1 which was supplanted on the assembly line by the Bf 110C which took advantage of the increased power offered by the later engines. Structurally strengthened and featuring a revised cockpit enclosure, the Bf 110C



(*Above*) *A Bf* 110*E*-1 *fighter-bomber.*

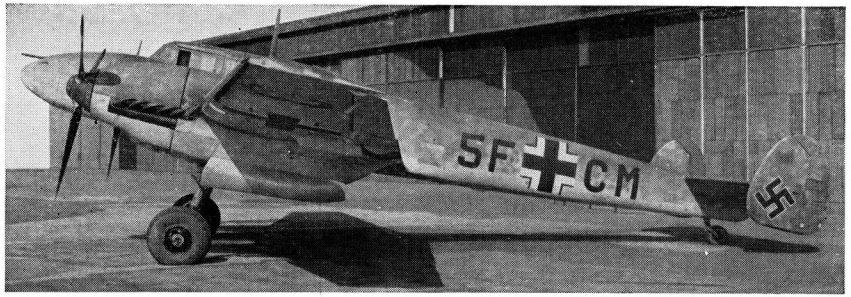
was fitted with a pair of 1,100 h.p. DB 601A engines, and the first pre-production Bf 110C-0 fighters were delivered to Luftwaffe test centres in February, 1939, closely followed by the fully operational Bf 110C-1 which was to equip Reichsmarshal Göring's new *zerstörer* units —the strategic fighter élite of the Luftwaffe. The Bf 110C-2 differed from the initial production model only in having revised electrical systems and new radio, while the C-3 and C-4 were respectively similar to the C-1 and C-2 apart from having improved MG FF cannon.

On the eve of World War II, the Zerstörergeschwader possessed 195 Bf 110C fighters plus reserves, and these were employed largely in the close-support role during the Polish campaign. Sub-types included the Bf 110C-2/U1 which was employed to test the remotely-controlled gun barbettes of the Me 210, the C-1/U1 glider tug converted from early production C-1 fighters for towing cargo gliders, and the Bf 110C-4B fighter-bomber with external racks for a 1,100-lb. bomb load and 1,200 h.p. DB 601N engines. The Bf 110C-5 was a fighter-reconnaissance model with a camera replacing the twin MG FF cannon in the lower part of the fuselage nose. Some 350 Bf 110C fighters were used by Luftflotten 2 and 3 for the invasion of France and the Low Countries, and 220 were available to the forces engaged in the "Battle of Britain". These received a disastrous mauling from the Hurricane and Spitfire, and it was soon found necessary to withdraw the twin-engined fighters from the Channel coast.

During 1940 a total of 1,083 Bf 110s was delivered, but production began to fall in the following year when only 784 machines were delivered. Several attempts were made to adapt the Bf 110C for specialised roles, and these included the Bf 110C-6 which carried a 30-mm. MK 101 cannon in a ventral fairing and was intended as a bomber destroyer, and the C-7 with a strengthened undercarriage which enabled it to carry a 2,200-lb. bomb load.

The Bf 110D was generally similar to the C-series but had improved range capabilities for the long-range escort role. The pre-production Bf 110D-0 discarded the twin MG FF cannon and carried a non-jettisonable ventral fuel tank of 230 Imp. gal. capacity, and had provision for two 198 Imp. gal. underwing tanks. The production Bf 110D-1 was not fitted with the ventral tank but had underwing shackles for fuel tanks of from 66 to 230 Imp. gal. capacity. The Bf 110D-2 was similar but equipped with shackles for two 1,100-lb. bombs, and the D-3 was a long-range fighter-bomber which could carry both bombs and long-range tanks. With the introduction of the Bf 110E-0 and E-1, provision was made for carrying four 110-lb. bombs under the outer wings in addition to the fuselage racks, and with the standardisation of the DB 601N in place of the DB 601A for the Bf 110E-2, maximum bomb load was raised from 2,645 lb. to 4,410 lb. The E-3 was a reconnaissance variant with reduced armament and two 198 Imp. gal. drop tanks.

With the introduction of the 1,300 h.p. DB 601F engine on the assembly lines, the Bf 110F

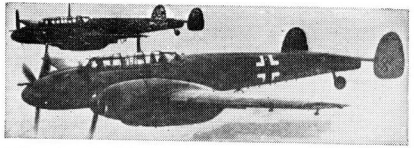


The Bf 110*C*-5 (*above*) *was a special reconnaissance model with a camera replacing the* 20-*mm. cannon.*

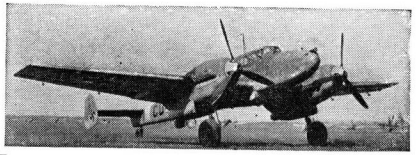
made its appearance, the F-0, F-1 and F-3 being otherwise identical to the E-0, E-1 and E-3, the Bf 110F-2 being a bomber-interceptor with four 21-cm. WG 21 rocket missile tubes mounted underwing. The Bf 110F-4 was produced specifically for G.C.I-controlled night fighting, carrying a third crew member and two 30-mm. MK 108 cannon in a ventral tray.

The following specification relates to the Bf 110C-4.

Type: *Two-seat Long-range Day and Escort Fighter.* **Power Plants:** *Two* 1,100 *h.p. Daimler-Benz DB* 601*A twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Four* 7.9-*mm. MG* 17 *machine guns and two* 20-*mm. MG FF cannon firing forward and one rear-firing* 7.9-*mm. MG* 15 *machine gun.* **Performance:** *Maximum speed,* 349 *m.p.h. at* 22,965 *ft.,* 294 *m.p.h. at sea level; maximum cruising speed,* 301 *m.p.h. at* 22,965 *ft.,* 263 *m.p.h. at sea level; range* (279 *Imp. gal.*), 481 *mls. at* 262 *m.p.h. at sea level,* 528 *mls. at* 304 *m.p.h. at* 16,400 *ft.,* 565 *mls. at* 301 *m.p.h. at* 22,970 *ft.; service ceiling,* 32,000 *ft.* **Weights:** *Normal loaded,* 15,300 *lb.* **Dimensions:** *Span,* 53 *ft.* 4⅞ *in.; length,* 39 *ft.* 8½ *in.; height,* 11 *ft.* 6 *in.; wing area,* 413 *sq. ft.*



(*Above*) *Bf* 110*C*-4 *long-range escort fighters and* (*below*) *a Bf* 110*C*-4/*B fighter-bomber.*

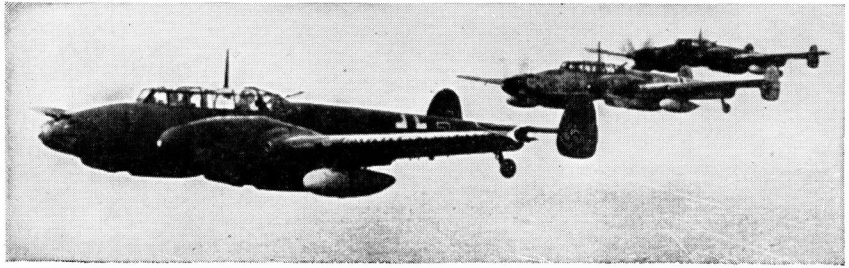


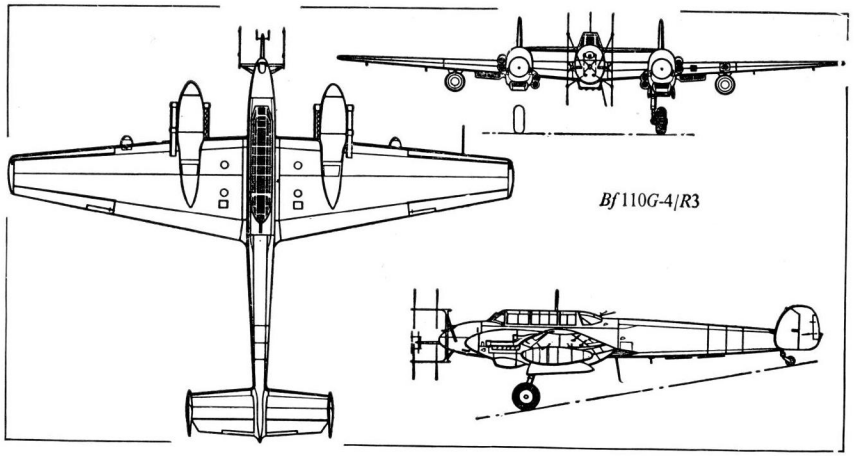
The cancellation of production of the Me 210 on April 14, 1942, left a serious gap in Germany's multi-engined fighter production programme. Manufacture of the Bf 110 was in process of tapering off, but the failure of its potential replacement necessitated a resumption of large-scale Bf 110 production, although a mere 580 machines were delivered during the course of 1942. To fill the gap left by the Me 210, a number of improvements were introduced on the Bf 110, the most important being the installation of 1,475 h.p. DB 605B engines.

The pre-production batch of DB 605B-powered machines, which received the designation Bf 110G-0, was delivered for service evaluation late in 1942. Armament was similar to that of the preceding F-models, and comprised four 7.9-mm. MG 17 machine guns with 1,000 r.p.g. and two 20-mm. MG FF cannon with 180 r.p.g. in the nose, and one rear-firing 7.9-mm. MG 15 machine gun with 750 rounds. Two 66 or 198 Imp. gal. drop tanks could be carried, and provision was made for two 1,100-lb. bombs under the fuselage and four 110-lb. bombs under the wings.

From early 1943 G-series machines were encountered in increasing numbers. The Bf 110G-1 was similar to the pre-production model, but the Bf 110G-2 featured a major boost in fire power. The four MG 17s were retained, but the twin MG FF cannon were replaced by a pair of faster-firing MG 151 cannon of similar calibre with 300 rounds for one gun and 350 for the other. This forward-firing armament could be supplemented by a pair of MG 151 cannon with 200 r.p.g. which could take the place of the bomb racks under the fuselage. In addition, twin 7.9-mm. MG 81 machine guns with 400 r.p.g. were mounted in the rear cockpit. Sub-variants included the Bf 110G-2/R1 heavy fighter with a 37-mm. BK 3.7 gun under the fuselage, the MG 151 cannon being discarded; the G-2/R2 which differed from the R1 in having a GM 1 power boost system and no bomb fusing gear or armour for the observer/rear-gunner; the G-2/R3 with a forward-firing armament of two 30-mm. MK 108 cannon and four 20-mm. MG 151 cannon; the G-2/R4 with a forward-firing armament of one 37-mm. BK 3.7 and two 30-mm. MK 108, and the G-2/R5 which was similar to the R4 but enjoyed the benefits of GM 1 power boost.

The Bf 110G-2 fighter-bomber was the first variant of the design to have MG 151 cannon.

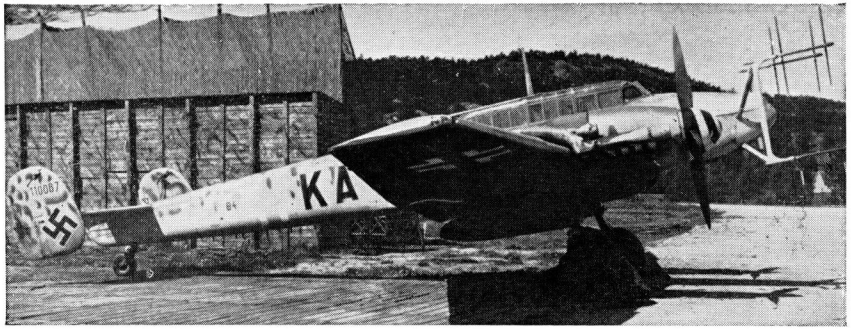




The Bf 110G-3 was a long-range reconnaissance aircraft carrying an RB 50/30 and an RB 75/30 camera. Forward-firing armament was reduced to four MG 17 machine guns, the twin MG 81s in the rear cockpit were retained, and in addition a fixed rear-firing MG 151 cannon with 350 rounds was carried.

With the increasing R.A.F. night offensive against Germany, all subsequent G-series aircraft were built as night fighters, the first of these being the Bf 110G-4 which had a forward-firing armament of four MG 17s and two MG 151s, and FuG 212 radar. The Bf 110G-4/U7 differed in having GM 1 power boost, and the G-4/U8 had no power boosting equipment but differed from other G-4s in discarding the fuselage bomb racks. The Bf 110G-4/R3 had a forward-firing armament of two 30-mm. MK 108s and two 20-mm. MG 151s, and two 20-mm. MG FF cannon were bolted to the rear bulkhead of the aft cockpit to fire obliquely upwards in a "Shräge Musik" installation; the G-4/R6 was similar apart from having GM 1 boost, and the G-4/R7 was similar to the G-4/R3 apart from having a 119 Imp. gal. fuel tank in the space normally occupied by the third crew member.

In 1943 Bf 110 production was treble that of the previous year, 1,580 machines being delivered, and in 1944 production totalled 1,525 machines. Manufactured in parallel



The first version of the Bf 110 *to be built from the outset for night fighting was the Bf* 110*G*-4/*R*3.

with the G-series was the H-series which differed in having a modified nose for the improved mounting of two 30-mm. MK 108 cannon; strengthened fuselage, wing attachment points and undercarriage; a stiffened fin; a plastic shaft for changing the tailplane incidence; a hydraulically retractable tailwheel, and a strengthened undercarriage permitting an increase in maximum landing weight from 17,380 lb. to 18,930 lb.

The first H-series production model was the Bf 110H-2 heavy day fighter and fighter-bomber with the same forward-firing armament as the G-2. The H-2/R1 had a forward-firing armament of two MK 108s and a 37-mm. BK 3.7, and the H-2/R2 had a GM 1 installation. The Bf 110H-3 was a long-range reconnaissance model, and the H-4 was a night fighter. Like some G-model night fighters, the Bf 110H-4 sometimes carried both FuG 220 and FuG 212 airborne radar, the dual installation offsetting the poor close resolution of the FuG 220. The Bf 110H-4/U7 and U8 had similar equipment changes to the Bf 110G-4/U7 and U8.

By the end of 1944 production of the Bf 110 variants had finally tapered off, and the last forty-five machines were delivered during the first weeks of 1945. The following specification relates to the Bf 110G-4/R3.

Type: *Three-seat Night Fighter.* **Power Plants:** *Two* 1,475 *h.p. Daimler-Benz DB* 605*B twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Two* 30-*mm. MK* 108 *with* 135 *r.p.g., one* 20-*mm. MG* 151 *with* 300 *rounds and one* 20-*mm. MG* 151 *with* 350 *rounds firing forward, and two* 7.9-*mm. MG* 81 *machine guns firing rearward.* **Performance:** *Maximum speed,* 342 *m.p.h. at* 22,900 *ft.,* 311 *m.p.h. at sea level; range (maximum external fuel),* 1,305 *mls.; service ceiling,* 26,000 *ft.; time to* 18,000 *ft.,* 7.9 *min.* **Weights:** *Empty,* 11,220 *lb.; normal loaded,* 20,700 *lb.; maximum,* 21,800 *lb.* **Dimensions:** *Span,* 53 *ft.* 4⅞ *in.; length,* 41 *ft.* 6¾ *in.; height,* 13 *ft.* 1¼ *in.; wing area,* 413 *sq. ft.*

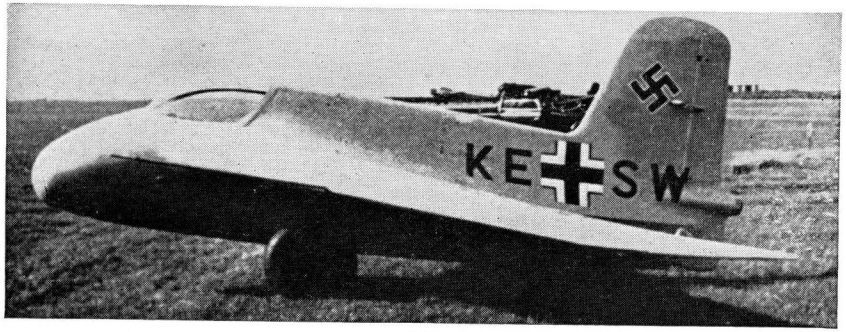
MESSERSCHMITT ME 163 KOMET

Audacious in concept, the Me 163 Komet designed by Prof. Alexander Lippisch was the only interceptor fighter powered solely by a rocket motor to see operational service. The Komet was derived from the DFS 194, construction of which was initiated by the Deutsche Forschungsanstalt für Segelflug (German Research Institute for Sailplanes) in 1938 as a low- and medium-speed test airframe for rocket motors. In January 1939 Lippisch and his team were transferred to the Messerschmitt A.G. to continue the development of a high-speed machine which, based on the DFS 194, was given the R.L.M. designation Me 163. The original DFS 194 airframe was completed by Messerschmitt and flown at Peenemünde-Karlshagen in 1940 with a 600-lb. thrust Walter HWK R.I rocket motor.

The airframes of the first two high-speed prototypes, the Me 163V1 and V2, were completed in the spring of 1941, preliminary flight tests being made without the rocket motor installed. In the summer the Me 163V1 was transported to Peenemünde-Karlshagen where a 1,650 lb. thrust HWK R.II motor was fitted. The first powered flight was made in August 1941, and on the fourth powered flight, Heini Dittmar attained 570 m.p.h. in level flight before exhausting the limited fuel carried. On October 2, 1941, after being towed to 13,000 ft., Dittmar attained 623.85 m.p.h. within two minutes of casting-off from the towplane. Until this time the Me 163 had been considered primarily as a research aircraft, but the successful results of trials led the R.L.M. to propose the development of the basic design as an interceptor.

In December 1941, Professor Lippisch and his team began redesigning the Me 163 for operational purposes. The HWK R.II employed by the Me 163V1 and V2 burned

The Me 163*V*1 *was originally built as a high-speed rocket-driven research aircraft.*



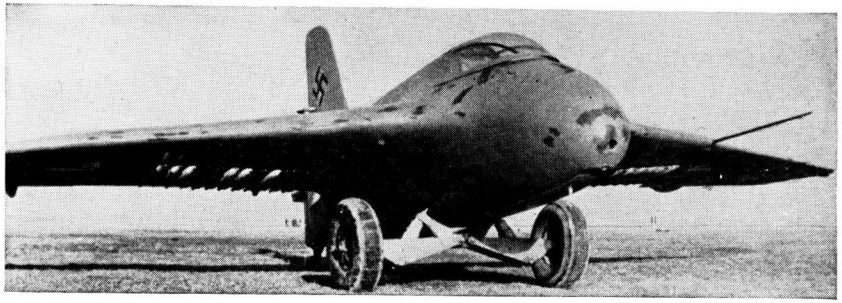
T-stoff (hydrogen-peroxide and water) using calcium permanganate as a catalyst, but this tended to clog the jets with the result that pressure and thrust fluctuated considerably. Hellmuth Walter therefore developed a new motor employing C-stoff (hydrazine hydrate and methyl alcohol) as a catalyst, and this was eventually to be produced as the HWK 509 for the Me 163B. The prototype for the B-series, the Me 163V3, was completed in May 1942. This had provision for armament and other operational equipment, the fuel tankage was substantially increased, and both the fuselage and wing were entirely redesigned. Forty per cent of the wing leading edges were covered by adjustable slots for initial gliding trials but these were later replaced by special low-drag fixed slots.

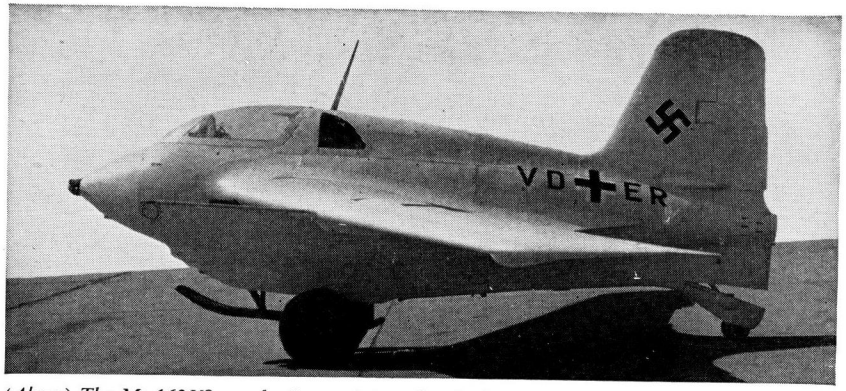
In the meantime, the Wolf Hirth glider concern had built ten gliders essentially similar to the Me 163V1 and designated Me 163A. These were intended for training purposes. The Messerschmitt factory at Regensburg was instructed to tool up for an initial series of seventy pre-production and production Me 163B interceptors, and all the airframes of the Me 163B-0 pre-production machines and those of more than half the initial batch of Me 163B-1 aircraft had been completed when, in the summer of 1943, the first HWK 509 arrived at Peenemünde for installation in the Me 163V3, the first powered flight of which took place in August.

With the availability of additional HWK 509 motors, most of the Me 163B-0s were allocated *Versuchs* numbers and joined the test programme, and at the end of June 1944, the first operational unit to receive the Me 163B-1 Komet, 1/J.G.400, was formed at Zwischenahn from the personnel of the Erprobungskommando 16 which had undertaken the task of developing training procedures and operational tactics for the revolutionary fighter. A second staffel was formed at the end of July, and 1 and 2/J.G.400 were sent to Brandis, near Leipzig, where, on August 16, 1944, they were first encountered by B-17 Fortresses.

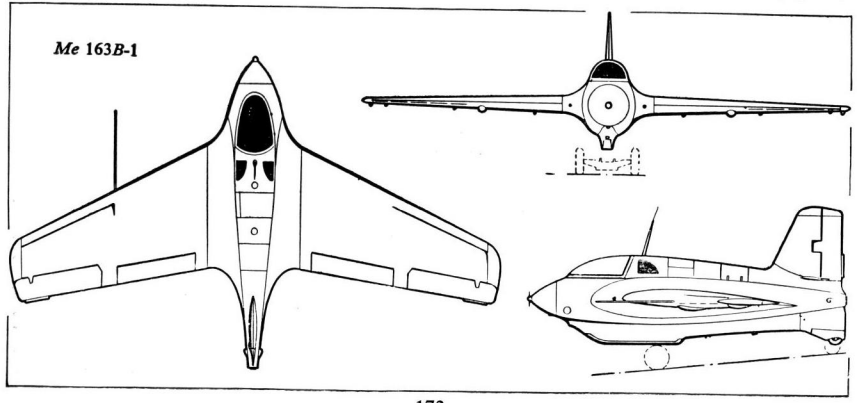
Although the Komet enjoyed considerable

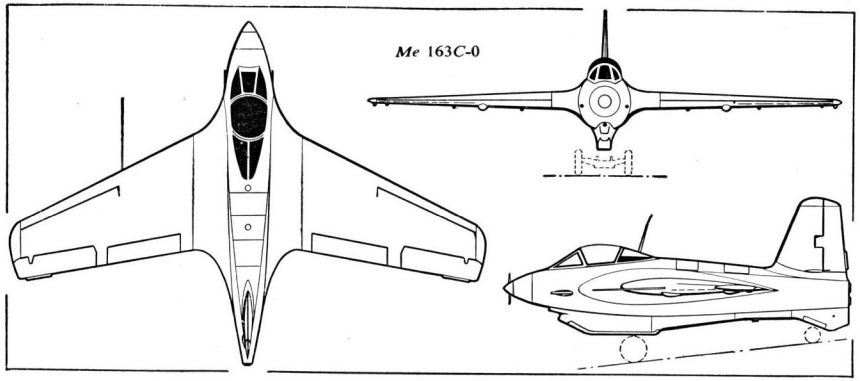
Ten Me 163As were built by Wolf Hirth for training, and that illustrated below has R4M rocket missiles.





(*Above*) *The Me 163V8, production prototype for the Me 163B Komet rocket-powered fighter.*





success against Allied bomber formations, it was an incalculable machine and highly dangerous to the pilots that flew it. Accidents were frequent, usually resulting from the explosion of remaining fuel on landing. Apart from the seventy Me 163B-0 and B-1 Komets built at Regensburg, less than a further 300 machines were completed.

Owing to the loss of efficiency of the rocket motor at low outputs Hellmuth Walter evolved an auxiliary cruising chamber which, giving 660 lb. thrust in addition to the 3,750 lb. thrust provided by the main chamber, was introduced on the HWK 509C first tested in the Me 163V6 in the summer of 1944. The auxiliary chamber increased powered flight endurance from eight to twelve minutes, and it was decided to employ this motor in the improved Me 163C incorporating a redesigned fuselage with a pressure cabin enclosed by a "bubble" canopy. Only a few pre-production Me 163C-0 fighters had been completed when the war terminated.

Data relating to the Me 163C is quoted in parentheses in the following specification.

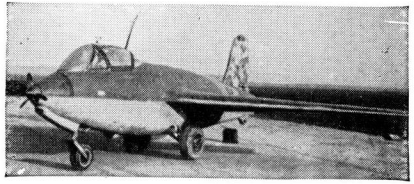
Type: *Single-seat Target-defence Interceptor.* **Power Plant:** *One* 3,750 *lb. thrust Walter HWK* 109-509*A*-2 *bi-fuel liquid rocket motor* (*one* 4,410 *lb. thrust Walter HWK* 109-509*C*). **Armament:** *Two* 30-*mm. MK* 108 *cannon with* 60 *r.p.g. and twenty-four R*4*M unguided rockets underwing, or four R*4*M rockets in each wing ejecting vertically upwards.* **Performance:** *Maximum speed,* 596 *m.p.h. at* 10,000–30,000 *ft.* (590 *m.p.h. at* 13,000–40,000 *ft.*), 515 *m.p.h. at sea level*; *endurance* (*after climb at* 495 *m.p.h.*), 2.5 *min.*; *maximum endurance,* 8 (12) *min.*; *initial climb rate,* 16,000 *ft./min.*; *time to* 30,000 *ft.,* 2.6 *min., to* 39,500 *ft.,* 3.35 *min.*; *service ceiling,* 39,500 (52,500) *ft.* **Weights:** *Empty,* 4,200 *lb.*; *loaded,* 9,500 (11,280) *lb.* **Dimensions:** *Span,* 30 *ft.* 7 *in.* (32 *ft.* 2 *in.*); *length,* 18 *ft.* 8 *in.* (23 *ft.* 1 *in.*); *height,* 9 *ft.* 0 *in.*; *wing area,* 211 *sq. ft.*

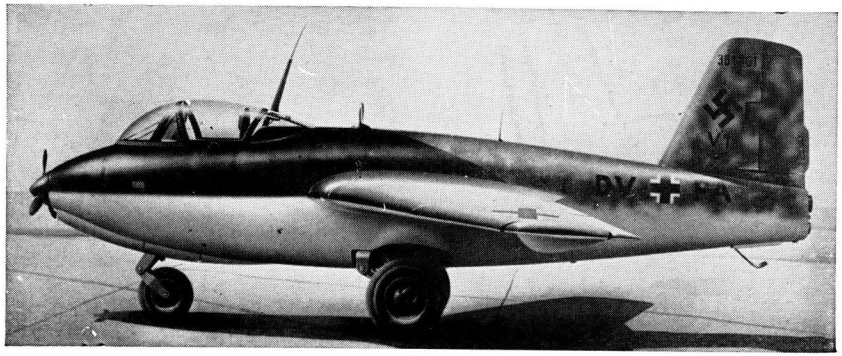
MESSERSCHMITT ME 263A

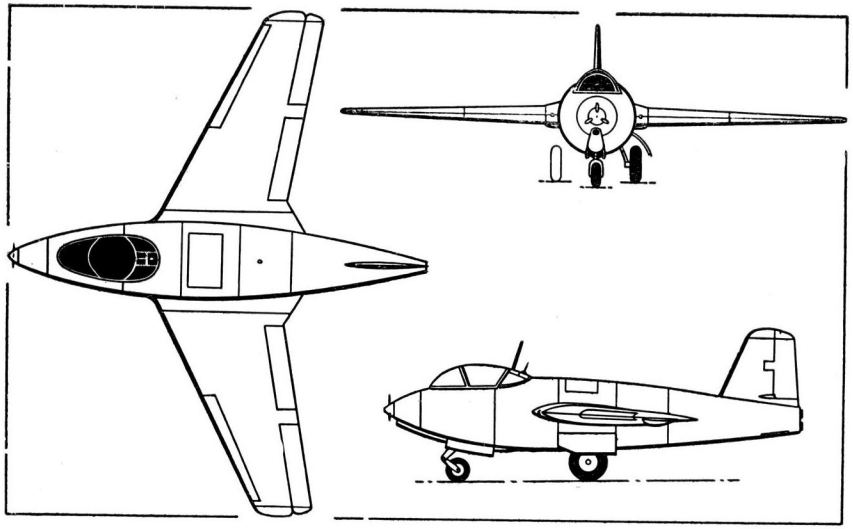
GERMANY

Early in 1944 the Messerschmitt A.G. began work on an improved target-defence interceptor derived from the Me 163C and initially designated Me 163D. The new fighter was appreciably cleaner than earlier versions of the Me 163, featuring an enlarged fuselage of improved aerodynamic form which had sufficient capacity to provide space for 352 Imp. gal. of T-stoff and 35 Imp. gal. of C-stoff, a further 150 gal. of C-stoff being accommodated in the wings which were similar to those of the Me 163B. A retractable tricycle undercarriage supplanted the earlier skids, the fin and rudder were standard Me 163B components, and the power plant was an HWK 509C similar to that of the Me 163C. The pressure cabin for the pilot was enclosed by an all-round vision "bubble" hood of sandwich construction.

At an early stage in the design of the Me 163D the fighter was handed over to the Junkers design staff at Dessau where it was completed by a team headed by Professor Heinrich Hertel, for a brief period being redesignated Ju 248. The first prototype was completed at Dessau in August 1944, by which time it had again been redesignated, now being known as the Me 263V1. For initial trials the







undercarriage was fixed in the "down" position, and several unpowered flight tests were made before, in the late autumn, development of the Me 263 was handed back to Messerschmitt, this concern undertaking the powered flight trials.

Armament was similar to that of the Me 163B, although ammunition capacity was increased, and the armoured nose cone of the earlier model was not fitted, but provision was made for extensive 12-mm. and 20-mm. armour protection for the pilot. Preparations for the quantity production of the Me 263A-1 were being made at the time of the German collapse.

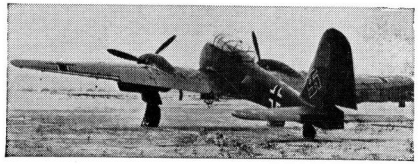
Type: *Single-seat Target-defence Interceptor.* **Power Plant:** *One* 4,430 *lb. thrust Walter HWK* 109-509*C bi-fuel liquid rocket motor.* **Armament:** *Two* 30-*mm. MK* 108 *cannon with* 75 *r.p.g.* **Performance:** *Maximum speed,* 620 *m.p.h. at* 10,000–36,000 *ft.; initial climb rate,* 13,800 *ft./min.; range (including climb but without glide at* 435 *m.p.h.),* 59 *mls. at sea level,* 90 *mls. at* 20,700 *ft.,* 102 *mls. at* 36,000 *ft.; powered endurance (at* 435 *m.p.h.),* 9 *min. at sea level,* 13.2 *min. at* 20,700 *ft.,* 15 *min. at* 36,000 *ft.* **Weights:** *Empty,* 4,640 *lb.; loaded,* 11,700 *lb.* **Dimensions:** *Span,* 31 *ft.* 2 *in.; length,* 25 *ft.* 10⅜ *in.; wing area,* 191.597 *sq. ft.*

MESSERSCHMITT ME 210A

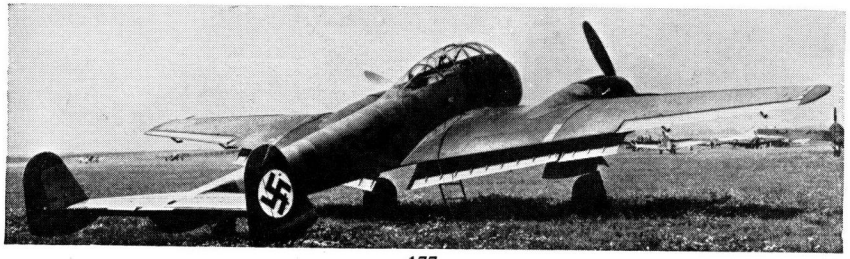
The Me 210 was first projected in 1937 as a more powerful and more versatile successor to the Bf 110 which, then being evaluated by the Luftwaffe, was already evincing a number of shortcomings. The project, submitted to the Reichsluftfahrtministerium, or R.L.M., in the autumn of 1937, envisaged an aircraft capable of undertaking the roles of medium-range heavy "destroyer", dive-bomber and reconnaissance, and the R.L.M. issued instructions to proceed before the end of the year. Prototype construction was initiated early in 1938, and from the outset an extremely advanced remotely-controlled armament system for rear defence was proposed. The first prototype, the Me 210V1 (D-AABF), Werk-Nr. 2345, was flown for the first time on September 2, 1939. This featured twin end-plate vertical tail surfaces generally similar to those of the Bf 110, and was powered by two Daimler-Benz DB 601A engines.

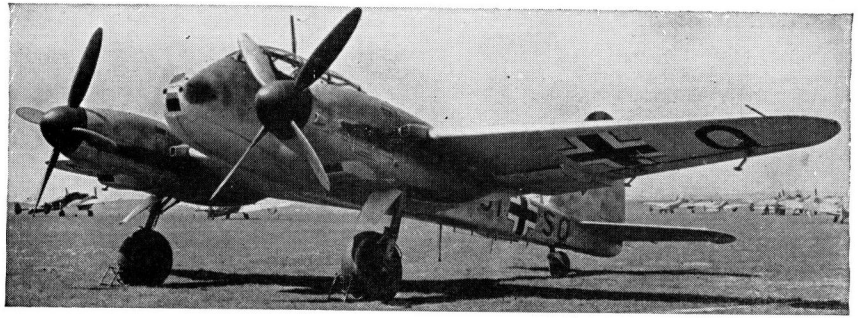
From the outset the Me 210V1 manifested marked longitudinal instability, and the second prototype, the Me 210V2, was extensively modified, the twin fins and rudders being discarded in favour of a single vertical surface. The Me 210V2 differed from its predecessor in several other respects, the cockpit canopy being redesigned and bulged at the sides, and mock-ups of the rear-firing remotely-controlled gun barbettes being fitted. Despite changes the Me 210V2 proved still to be an extremely unstable aircraft, and eventually crashed on September 5, 1940 during flutter tests.

The R.L.M. had placed a production order for 1,000 Me 210As before the first prototype had flown, and events proved this to have been a serious mistake. The first pre-production Me 210A-0 aircraft had reached Luftwaffe service test units before the end of 1940, and quantity deliveries of the Me 210A-1 heavy



(Below) The Me 210V1 and (right) the Me 210V2.



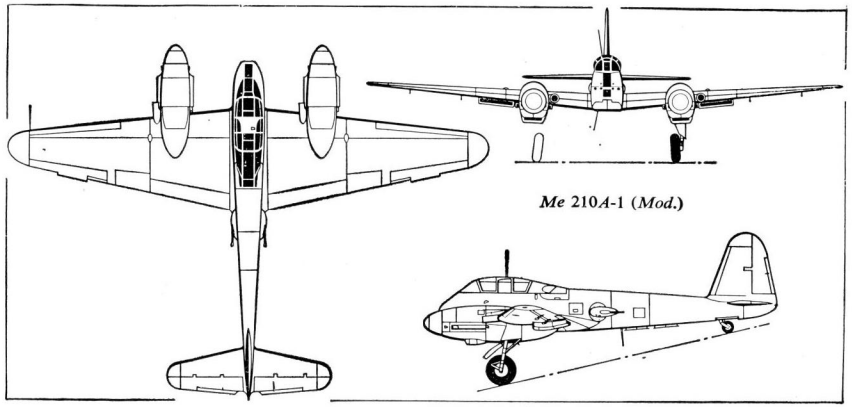


The Me 210*V*13 (*above*) *was intended to serve as a test-bed for the pressurized Me* 310.

fighter and Me 210A-2 fighter-bomber began early in 1941, ninety-four machines being delivered in that year, including two Me 210B-1 reconnaissance aircraft. Numerous accidents were suffered by units equipped with the new aircraft, and on several occasions the assembly line was halted while modifications were applied to the aircraft, including the lengthening of the fuselage from 36 ft. 8¼ in. to 40 ft. 3 in. Despite its obvious shortcomings, the Me 210A was thrown into service on the Russian Front late in 1941. The Me 210A-1 carried an armament of two 20-mm. MG 151 cannon and two 7.9-mm. MG 17 machine guns firing forward and two 13-mm. MG 131 machine guns firing aft from remotely-controlled rotatable barbettes attached to the fuselage sides aft of the wings. The Me 210A-2 fighter-bomber had external racks for a maximum load of two 2,200-lb. bombs, but normal offensive loads were two 1,100-lb. or 550-lb bombs. The Me 210B-1 photo-reconnaissance variant had the forward-firing armament reduced to two MG 151 cannon and carried two cameras. Projected production versions which did not materialise were the Me 210C-1, C-2 and D-1 which were respectively DB 605B-powered versions of the Me 210A-1, A-2 and B-1.

Despite numerous modifications, Luftwaffe units equipped with the Me 210 suffered an appallingly high accident rate, and on April 14, 1942, production of the aircraft was terminated by the R.L.M. At this time some 200 Me 210s had been delivered to the Luftwaffe, a further 370 were in various stages of assembly, and materials and components had been prepared for an additional 800 machines. The order resulted in many aircraft workers being without proper employment for many months, and the loss of at least 600 aircraft to the German war effort. The financial loss to the Messerschmitt concern was 30M Reichsmarks, and Erhard Milch insisted on the resignation of Professor Messerschmitt from his positions of Chairman of the Management Committee and General Director of the Messerschmitt A.G.

A planned improvement of the Me 210 was



the Me 310 which was to have featured a pressurized crew compartment and two 1,750 h.p. DB 603A engines. The Me 210V13 was employed to test the pressurization equipment for the Me 310 but, in the event, no prototype of the Me 310 was completed, the type being supplanted by the Me 410 Hornisse. In July 1942 one Me 210A was tested with leading edge slots which were found to improve the qualities of the aircraft in a sideslip, and this modification was applied retrospectively to completed Me 210As which were returned to operational service, the type appearing over the United Kingdom for the first time that summer when an Me 210A-1 was shot down by a Typhoon during a sneak attack on the South Coast. Limited production of the Me 210A was later resumed, a number of the machines that had reached an advanced stage when production was terminated being completed, bringing total production to 352 aircraft.

Type: *Two-seat Medium-range Fighter* (*A*-1) *and Fighter-Bomber* (*A*-2). **Power Plants:** *Two* 1,395 *h.p. Daimler-Benz DB* 601*F twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** *Two* 20-*mm. MG* 151 *cannon, two* 7.9-*mm. MG* 17 *machine guns and two* (*remotely-controlled, rearward-firing*) 13-*mm. MG* 131 *machine guns plus* (*A*-2) *two* 1,100-*lb. bombs internally and two* 1,100-*lb. or* 550-*lb. bombs externally, or two* 2,200-*lb. bombs externally.* **Performance:** *Maximum speed,* 385 *m.p.h.; range,* 1,491 *mls.; service ceiling,* 22,965 *ft.* **Weights:** *Loaded* (*A*-1), 17,857 *lb.; maximum loaded* (*A*-2), 25,150 *lb.* **Dimensions:** *Span,* 53 *ft.* 7¼ *in.; length,* 40 *ft.* 3 *in.; height,* 14 *ft.* 0½*in.; wing area,* 389.654 *sq. ft.*

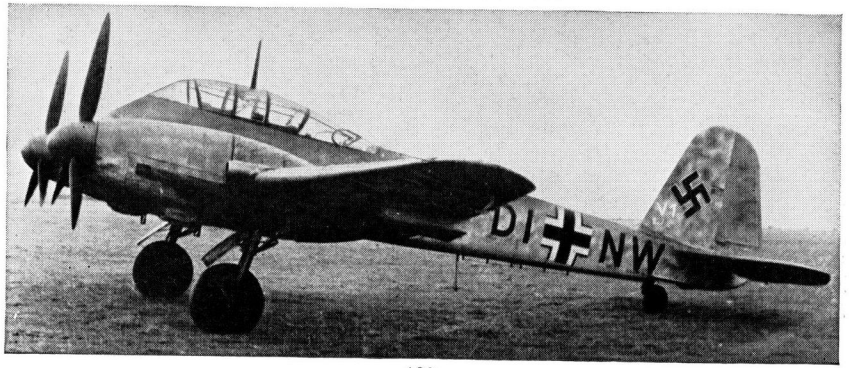
MESSERSCHMITT ME 410 HORNISSE

GERMANY

With the failure of the Me 210, the Messerschmitt design team proposed the Me 310 with a pressurized cabin and two 1,750 h.p. DB 603A engines. The armament of the Me 310 was to have remained the same as that of the Me 210A-1 and various improvements were to have been incorporated, including an increase in overall wing span to 59 ft. 0¾ in. The loaded weights of the fighter and bomber versions were estimated at 21,976 lb. and 24,399 lb. respectively, and it was anticipated that the former would have a maximum speed of 419 m.p.h. and a ceiling of 36,090 ft. In order to simplify production, however, the R.L.M. showed a preference for a less radically altered development of the Me 210 which was designated Me 410 and named Hornisse (Hornet).

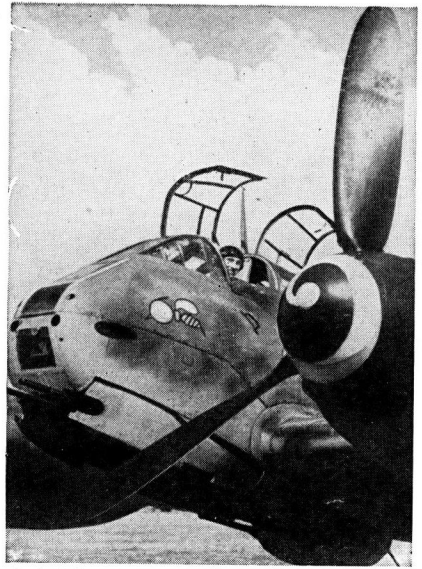
Apart from the installation of DB 603A engines, which increased overall length by some eight inches over that of the modified Me 210A, the Hornisse was essentially similar to the earlier machine with all its progressive modifications, such as leading-edge slots. The first true prototype of the Hornisse, the Me 410V1, was completed after a batch of six Me 210As had been modified to Me 410 standards for service testing, and towards the end of 1942 the R.L.M. ordered quantity production to be initiated, 291 machines being delivered in 1943, and 722 being produced in 1944 when further manufacture of the type was abandoned. Production of the Me 410 was also undertaken in Hungary by the Donau Flugzeugbau for the Luftwaffe, this concern's plant south of Budapest producing thirty-four machines in 1943, and a further seventy-four by July 1944 when the plant was knocked out by Allied air attacks.

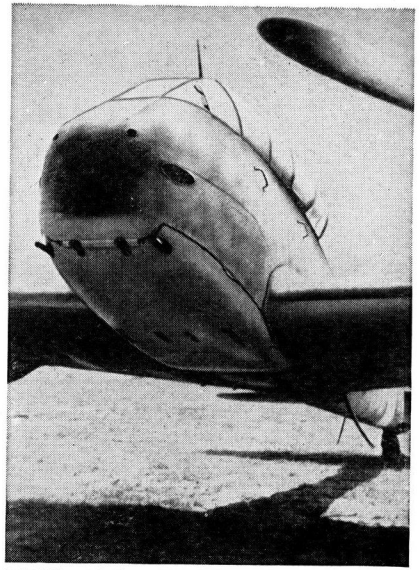
The Me 410V1 was derived from the Me 210A and fitted with DB 603A engines. Quantity production was ordered in 1942.



The Me 410B-2/U1 was a bomber destroyer with a WT 151A fairing housing twin MG 151 cannon.

The initial production model of the Hornisse was the Me 410A-1 light bomber with a fixed forward-firing armament of two 7.9-mm. MG 17 and two 20-mm. MG 151 guns plus two 13-mm. MG 131 guns firing aft from remotely-controlled rotatable barbettes. The maximum internal bomb load was two 2,200-lb. SD 1000 bombs, but a more usual load was eight 110-lb. SC 50 bombs internally and four similar bombs externally on racks beneath the wing roots. The Me 410A-1/U1 was a photo-reconnaissance modification with the two forward-firing MG 17 machine guns deleted and an RB 20/30, 50/30 or 75/30 camera in the bomb-bay. The Me 410A-1/U2 was a "destroyer" conversion in which the built-in armament was supplanted by a WB 151A (Waffen-Behälter 151A), a drum-like container housing twin 20-mm. MG 151 cannon and their ammunition, and installed in the bomb-bay. The Me 410A-1/U4 was a bomber destroyer carrying a 50-mm. BK 5 cannon—an old





(Left) The Me 410B-2/U1 and (right) the Me 410B-2/U2 with four MG 151 cannon in the bomb-bay.

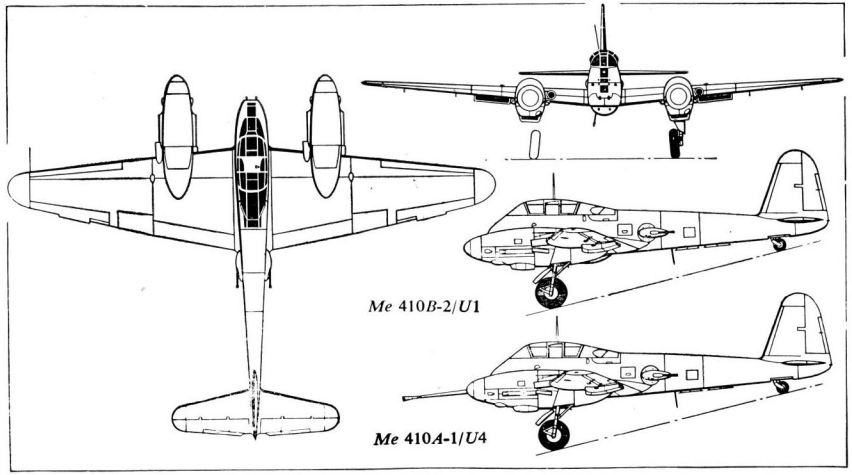
armoured car gun adapted for aircraft use—all other forward-firing armament being deleted.

The Me 410A-2 was a destroyer and the last of the A-series aircraft was the Me 410A-3 photo-reconnaissance aircraft which carried three cameras in a swollen bomb-bay. Production continued with the B-series Hornisse, the Me 410B-1 differing from the A-1 principally in having the forward-firing 7.9-mm. MG 17 machine guns replaced by 13-mm. MG 131s, and being intended for the light bomber role. The Me 410B-2 was a destroyer with a WB 151A container in its bomb-bay, and the B-2/R2 and R3 respectively carried a pair of 30-mm. MK 108 and MK 103 cannon supplementing the normal forward-firing armament.

The Me 410B-2/U1 had the standard built-in armament plus a WB 151A installation and a WT 151A (Waffen-Tropfen 151A) installation

which was a bulged fairing mounted externally at the aft end of the bomb-bay and containing two 20-mm. MG 151 cannon and their ammunition.[1] Forward-firing armament of this variant thus became six MG 151 cannon and two MG 131 machine guns. The Me 410B-2/U2 carried four 20-mm. MG 151 cannon in the bomb-bay, and the B-2/U3 was an anti-shipping aircraft with the two forward-firing MG 131s deleted to make room for an FuG 200 Hohentwiel search radar array, two 30-mm. MK 103 cannon mounted in the bomb-bay, and provision for a single torpedo under the fuselage. The final production sub-type was the Me 410B-3 reconnaissance-fighter, which carried the standard gun armament and three cameras in a swollen bomb-bay.

Type: *Two-seat Heavy Fighter and Bomber Interceptor.* **Power Plants:** *Two* 1,750 *h.p. Daimler-Benz DB* 603*A twelve-cylinder inverted-Vee liquid-cooled engines.* **Armament:** (*A*-1/*U*2) *Four forward-firing* 20-*mm. MG* 151 *cannon and two* 7.9-*mm. MG* 17 *machine guns plus two rear-firing remotely-controlled* 13-*mm. MG* 131 *machine guns*; (*B*-2/*U*1 *and U*2) *six forward-firing* 20-*mm. MG* 151 *cannon and two* 13-*mm. MG* 131 *machine guns plus two rear-firing MG* 131 *machine guns.* **Performance:** (*A*-1/*U*2) *Maximum speed*, 388 *m.p.h. at* 21,980 *ft.*; *maximum range*, 1,450 *mls.*; *climb to* 21,980 *ft.*, 10.7 *min.*; *service ceiling*, 32,800 *ft.* **Weights:** *Empty*, 13,550 *lb.*; *loaded*, 23,500 *lb.* **Dimensions:** *Span*, 53 *ft.* 7¾ *in.*; *length*, 40 *ft.* 11⅓ *in.*; *height*, 14 *ft.* 0½ *in.*; *wing area*, 389.654 *sq. ft.*



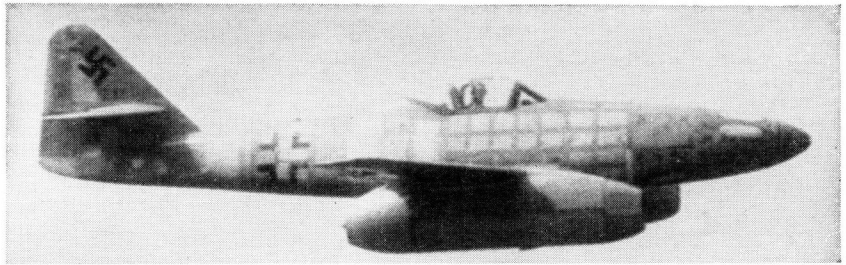
MESSERSCHMITT ME 262

GERMANY

The first turbojet-driven fighter to attain operational status, the Me 262 is famed for the radical innovations that it introduced or utilised for the first time in practical form rather than for its operational exploits, for, had it not been for remarkable vacillation over its development on the part of Germany's leaders, the Me 262 might have regained for the Luftwaffe the ascendancy that it enjoyed during the early stages of the war. In the event, fewer than fifteen per cent of the 1,433 Me 262s were employed operationally, and many of these were wasted on close-support duties, a role for which the aircraft was unsuited.

In 1938 the Reichsluftfahrtministerium placed an order with the Messerschmitt A.G. for the design of an airframe suitable to accommodate the revolutionary new turbojets that were being developed by the Junkers and BMW concerns. The design received the Messerschmitt project designation P.1065, and the first mock-up inspection was made by R.L.M. officials on December 19, 1939, a contract for three prototype airframes being awarded on March 1, 1940. As the turbojets intended to power the new aircraft, which, by this time had received the designation Me 262, were being developed under low priority, the airframes were completed long before any power plants were available for installation. In order to determine the flight characteristics of the aircraft, the first prototype, the Me 262V1, was therefore fitted with a 700 h.p. Junkers Jumo 210G piston engine with which it flew for the first time on April 4, 1941. Some seven months later, two 1,000 lb.s.t. BMW 003 turbojets were fitted to the Me 262V1, and on November 25, 1941, with the Jumo 210G retained for precautionary purposes, a flight was attempted, but both turbojets suffered

The Me 262V3 (below) was the first prototype to fly solely on the power of turbojets.



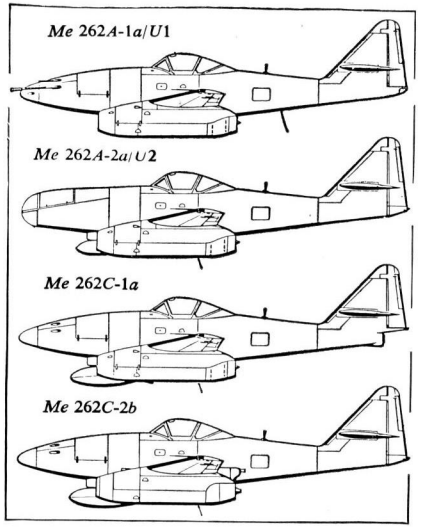
The initial production model, the Me 262A-1a Schwalbe, was delivered in May 1944.

blade failures at take-off revolutions, and further attempts to fly the Me 262V1 with these power plants were abandoned.

The first flight solely on turbojet power was not effected until July 18, 1942, this being made by the third prototype, the Me 262V3, on the 1,850 lb.s.t. supplied by each of two Junkers Jumo 004s. The Me 262V3 was destroyed on August 11, 1942 while under test at Rechlin, but on October 2nd the similarly-powered Me 262V2 was flown successfully. At this time only fifteen Me 262s had been ordered, but after the flight of the second prototype, a further forty-five machines were ordered. The Me 262V1, rebuilt after suffering damage during the abortive trials with the BMW turbojets, was fitted with Jumos and flown on March 2, 1943, this aircraft being joined at Messerschmitt's Lechfeld test centre by the Me 262V4 in April.

All these prototypes had tailwheels which resulted in severely restricted view from the cockpit during take-off and, with the c.g. aft, it was necessary to apply the brakes at 100 m.p.h. in order to get the tail off the ground prior to taking-off. Thus, the Me 262V5 was fitted with a fixed nosewheel undercarriage. In addition two 1,100-lb. thrust Borsig rocket units were fitted to assist take-off. The nosewheel of the next prototype, the Me 262V6, was fully retractable, and this was the first aeroplane to receive the up-rated Jumo 004B turbojets. The Me 262V7 had a rubber-sealed pressurised cockpit; the V8 carried the first armament installation which consisted of four 30-mm. MK 108 cannon; the V9 tested FuG 25A I.F.F., FuG 24 R/T, and other radio and navigational equipment, and the V10, first flown on May 1, 1944, tested methods of reducing stick forces at high speeds before being fitted with bomb pylons to test the aircraft's suitability for high-speed bombing.

In the meantime the first of the thirteen pre-production Me 262A-0 fighters had been flown, and the R.L.M. at last recognised the worth of the new fighter, this being indicated by its Programme 223 which called for a production rate of sixty machines per month from May 1944, with mass production commencing as soon as tooling, raw materials and labour became available. However, the greater part of the assembly fixtures for the fuselage had been destroyed on August 17, 1943, in the first air attack on Regensburg, and this,

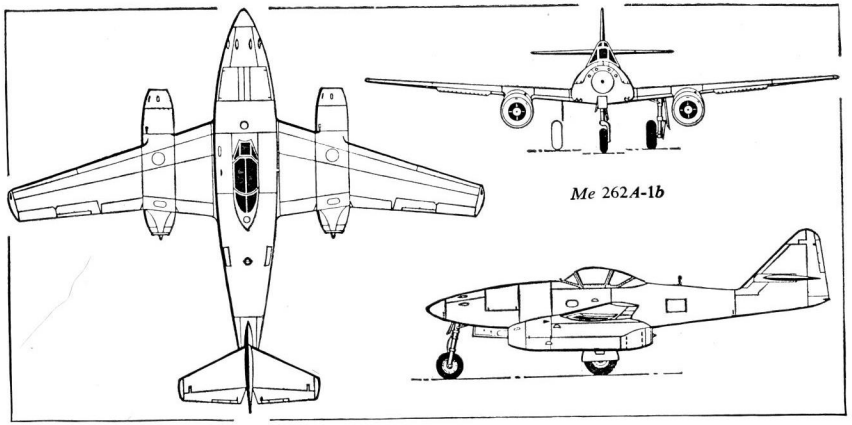


together with the transfer of the development programme from Augsburg to Oberammergau, seriously delayed production.

The initial production model, the Me 262A-1a, was named the Schwalbe (Swallow) and was intended solely for the interceptor role. This carried an armament of four 30-mm. MK 108 cannon, and several sub-types were produced, including the Me 262A-1a/U1 with two 30-mm. MK 103s, two 30-mm. MK 108s and two 20-mm. MG 151s; the Me 262A-1a/U2 with four MK 108s and extra radio equipment to suit it for bad weather fighting; the Me 262A-1a/U3 with two RB 50/30 vertical cameras in place of the nose armament, and the Me 262A-1b which was a later modification with racks underwing for twenty-four 5-cm. R4M air-to-air rockets. Adolf Hitler's preoccupation with "revenge weapons" soon manifested itself, however, with an order to convert all existing Schwalbe fighters as attack bombers. The changes thus rendered necessary resulted in a delay of at least four months in the tactical employment of the Me 262.

The conversion of the Schwalbe for the attack bomber role resulted in the Me 262A-2a Sturmvogel (Stormbird) which carried two 550-lb. bombs beneath the forward fuselage and the standard armament of four MK 108 cannon. The Me 262A-2a/U1 had two MK 108s removed to provide space for the installation of a TSA bomb-aiming device, and the A-2a/U2 carried a second crew member in a prone position in the fuselage nose with a Lotfe 7H bomb-sight. Only one prototype of the last-mentioned version was produced. The Me 262A-3a was intended for the duel role of ground support and interception and featured additional armour protection for the cockpit and fuel tanks, and the Me 262A-5a was a reconnaissance-fighter with two 30-mm. MK 108s, two RB 50/30 cameras and pylons for two 66 Imp. gal. fuel tanks or one 132 Imp. gal. tank under the forward fuselage.

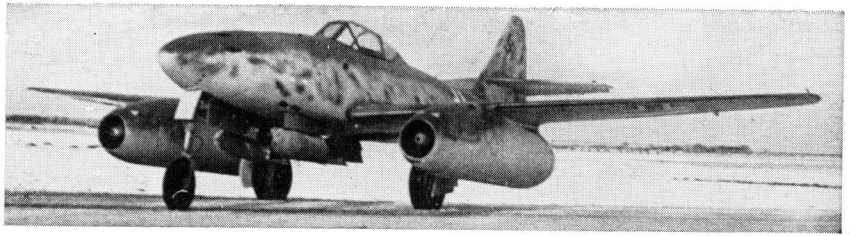
A training programme for Me 262 pilots was initiated in November 1944, III/Erg. Jagdgeschwader 2 being formed at Lechfeld from the staff of Erprobungskommando 262, the unit engaged in the operational perfection of the fighter. To assist in the training programme and to reduce the high accident rate which had resulted from the erroneous belief that the jet fighter called for no specialised training, a tandem two-seat model, the Me 262B-1a, was produced. The installation of a second cockpit was effected at the expense of internal fuel capacity, necessitating the attachment of



pylons under the forward fuselage to carry two 66 Imp. gal. fuel tanks, and a number of Me 262B-1a trainers were delivered to III/E.J.G.2, some fifteen being completed.

Proposals for night fighting versions of the Me 262 were first made in 1944, and a single-seat machine was experimentally fitted with an SN-2 Lichtenstein radar array in the nose. This led to the decision to adapt the Me 262B-1a trainer as an interim night fighter under the designation Me 262B-1a/U1. FuG 218 airborne interception and tail warning radar, FuG 350ZC Naxos homing radar, and an EBL-3 blind approach system were installed, and the normal MK 108 cannon armament was retained. Three Me 262B-1a/U1 conversions were completed, although the drag of the radar array which reduced maximum speed by 37 m.p.h. occasioned some concern. The production adaptation of the basic design for night fighting was the Me 262B-2a which had a 3 ft. 11¼ in. increase in overall fuselage length resulting from the insertion of an additional fuselage section to increase internal fuel capacity from 380 Imp. gal. to 638 Imp. gal. The four forward-firing MK 108s were supplemented by two obliquely-mounted MK 108s aft of the cockpit. Only one prototype of the Me 262B-2a was flight tested, and a second prototype with centimetric radar in a blunt-tipped nose (which was expected to increase maximum speed by 30 m.p.h.) was ready for testing at the time of the collapse.

Several rocket-boosted interceptor variants were proposed. These included the Me 262C-1a which had a Walter HWK 109-509 bi-fuel rocket motor in the tail, a 198 Imp. gall. C-stoff tank ahead of the pilot, and a drop-tank containing T-stoff. The prototype Me 262C-1a was flown for the first time on February 27,



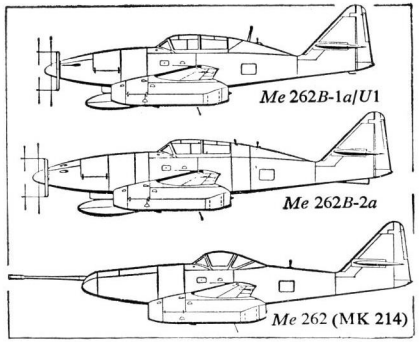
(*Above and left*) *The Me 262A-2a Sturmvogel.*

1945, and during trials attained an altitude of 38,400 ft. from a standing start in 4.5 minutes. The Me 262C-2b was fitted with BMW 003R mixed-power units, each of which comprised a standard 1,760 lb.s.t. BMW 003A turbojet and a 2,700 lb. thrust BMW 718 bi-fuel rocket. Owing to difficulties encountered in providing satisfactory seals and gaskets for the rocket fuel tanks, only one flight was made before it was decided to concentrate on the simpler Me 262C-3 with a jettisonable Walter rocket mounted in a pod under the fuselage and fed from a jettisonable fuel tank mounted ahead of the motor. No tests with the Me 262C-3 were conducted.

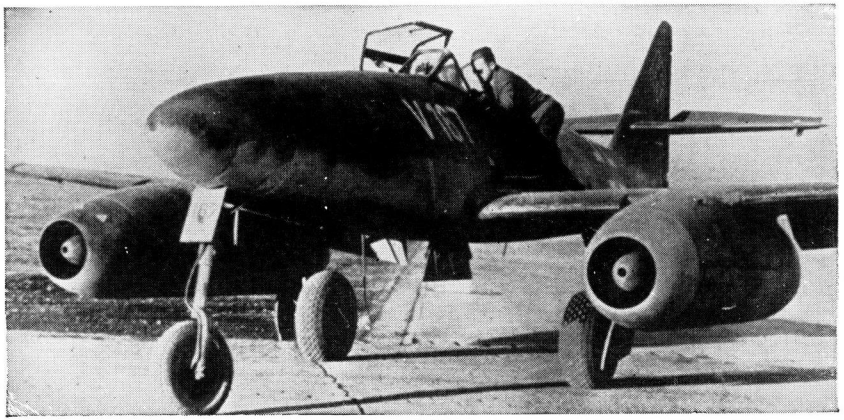
Four Me 262A-1a airframes were modified to carry a single 50-mm. MK 214A cannon for attacks on bombers. The MK 214A had a fire rate of 75 r.p.m., but normally only one round would be fired at a time owing to the blinding flash from the gun, the barrel of which projected almost 7 ft. ahead of the fuselage. During firing trials with the MK 214A a test pilot scored twenty-seven hits out of a possible thirty on a rectangular target thirty-five yards long from a distance of 1,300–1,640 yards. Maximum speed with the MK 214A installed was 525 m.p.h. The proposed Me 262D was to have been fitted with the SG 500 Jagdfaust which comprised twelve rifled mortar barrels situated in the nose of the aircraft pointing forward and upward. Each barrel was to have contained a 50-mm. shell, all twelve being fired simultaneously, recoil being counteracted by counterweights fired downwards from the barrels. The Me 262E was a further projected version carrying twenty-four R4M missiles in a nose container and twelve under each wing.

A total of 1,433 Me 262s was produced in Germany, and approximately 497 additional machines were lost as a result of bombing attacks before completion. The following specification relates to the Me 262A-1a.

Type: *Single-seat Interceptor Fighter.* **Power Plants:** *Two* 1,980 *lb.s.t. Junkers Jumo* 004*B*-**1**, -2, *or* -3 *axial-flow turbojets.* **Armament:** *Four* 30-*mm. MK* 108 *cannon with* 100 *r.p.g.* (*two upper*) *and* 80 *r.p.g.* (*two lower*) *plus twenty-four* 5-*cm. R4M air-to-air rocket missiles.* **Performance:** *Maximum speed,* 538 *m.p.h. at* 29,560 *ft.,* 540 *m.p.h. at* 19,684 *ft.,* 500 *m.p.h. at sea level; initial climb rate,* 3,937 *ft./min.; service ceiling,* 37,565 *ft.; range,* 298 *mls. at sea level,* 526 *mls. at* 19,684 *ft.,* 652 *mls. at* 29,560 *ft.* **Weights:** *Empty,* 9,741 *lb.; loaded,* 14,101 *lb.* **Dimensions:** *Span,* 40 *ft.* 11½ *in.; length,* 34 *ft.* 9½ *in.; height,* 12 *ft.* 7 *in.; wing area,* 234 *sq. ft.*



(*Below*) *An Me 262A-1a of a test unit. Accident rate was high initially owing to the belief that no specialised training was necessary.*



MESSERSCHMITT ME 309

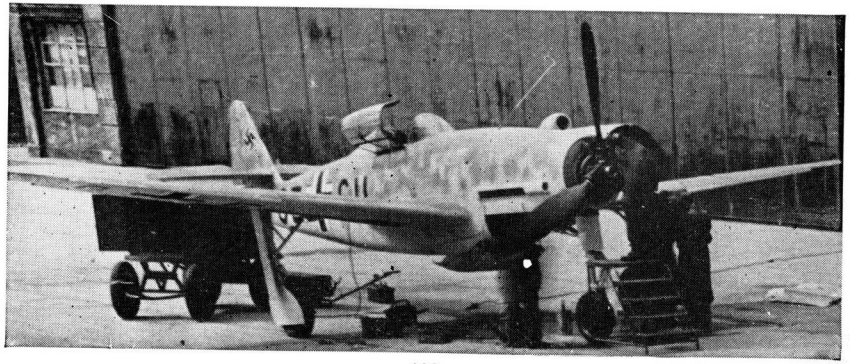
GERMANY

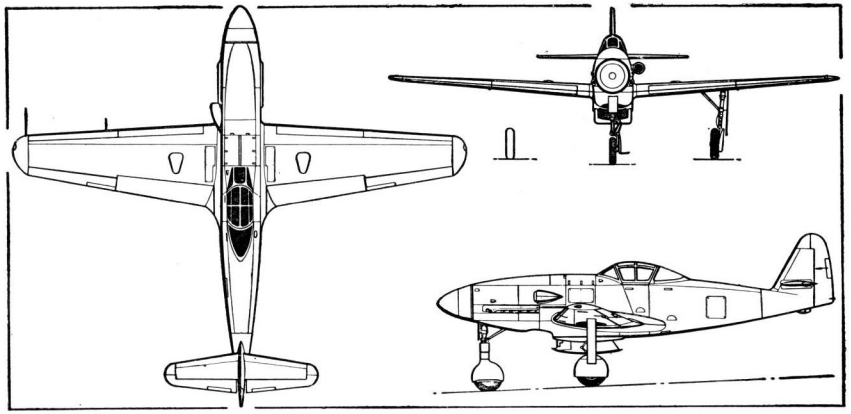
During 1941 the Messerschmitt A.G. began design work on a new fighter intended to succeed the Bf 109. Designated Me 309, the new fighter employed a nosewheel undercarriage.

The first prototype, the ME 309V1 (GE+CU), began taxi-ing trials at Augsburg-Haunstetten on June 27, 1942, but owing to serious nosewheel wobble and some directional snaking, the first test flight was not attempted until July 18, 1942. This flight lasted only five minutes as the temperature of the coolant liquid rose alarmingly, and inadequate hydraulic power prevented the efficient retraction of the undercarriage. Subsequent flight tests revealed some instability, and the prototype was grounded for modifications to the ailerons, tailplane, nosewheel leg and hydraulic pump, resuming flight trials on August 5, 1942.

Despite continual modification, the characteristics of the fighter were still not entirely satisfactory when, on November 20th, the Me 309 V1 was flown by the Rechlin test pilot Beauvais. A subsequent flight comparison between the prototype and a standard Bf 109G revealed the fact that the older fighter could out-turn its potential successor. In his report after evaluating the prototype, Beauvais stated: "The Me 309 will be acceptable after certain improvements have been effected, but it should be stressed that this fighter will provide the average service pilot with handling difficulties. Control forces are very high by comparison with those of current fighters, and the nosewheel undercarriage is likely to offer problems when the fighter uses operational airfields."

The second prototype, the Me 309V2 (GE+CV), was flown for the first time on November 28, 1942, but this aircraft was written off when the nosewheel leg collapsed during the first landing. Flight testing with the Me 309V1 continued, during the course of which the





DB 603A engine was replaced by a DB 605, and in the spring of 1943 it was joined by the Me 309V3 (GE+CW) which embodied numerous modifications dictated by tests with the first prototype. The Me 309V4, which flew in July 1943, was fitted with two wing-mounted MK 108 cannon, two MG 131 machine guns and two MG 151 cannon in the wing roots, and two MG 131s in the fuselage. During the summer, however, the complete programme was abandoned owing to the superior qualities of the Fw 190D and Ta 152.

Prior to the termination of the programme several variants of the basic design were proposed, including the Me 309A-1 fighter and Me 309B-1 dive-bomber with two 550-lb. bombs. It was envisaged that the DB 603H engine would eventually supplant the DB 603A-1, and a variant powered by the Junkers Jumo 213 was also proposed. A development, the Me 609, with two Me 309 fuselages joined by a constant-chord centre wing, was not proceeded with.

Type: *Single-seat Short- and Medium-range Interceptor.* **Power Plant:** *One* 1,750 *h.p. Daimler-Benz DB* 603*A*-1 *twelve-cylinder inverted-Vee liquid-cooled engine.* **Armament:** *proposed light version, one* 30-*mm. MK* 103 *or MK* 108 *cannon and two* 13-*mm. MG* 131 *machine guns; heavy version, one* 30-*mm. MK* 103 *or MK* 108 *cannon, two* 20-*mm. MG* 151 *cannon and four* 13-*mm. MG* 131 *machine guns.* **Performance** (*Me* 309*A*-1)*: Maximum speed,* 405 *m.p.h. at sea level,* 496 *m.p.h. at* 26,200 *ft.,* 481 *m.p.h. at* 32,800 *ft.; time to* 32,800 *ft.,* 11 *min.; service ceiling,* 39,300 *ft.; range,* 870 *mls. at* 393 *m.p.h. at* 26,300 *ft.* **Weights:** *Normal loaded* (*light armament*) 7,600 *lb.; maximum loaded,* 9,049 *lb.* **Dimensions:** *Span,* 36 *ft.* 1 *in.; length,* 31 *ft.* 4½ *in.; wing area,* 170 *sq. ft.*

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